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NATIONAL DAM SAFETY PROGRAM. RIO DAM (INVENTORY NUMBER NY 497),--ETC(U)
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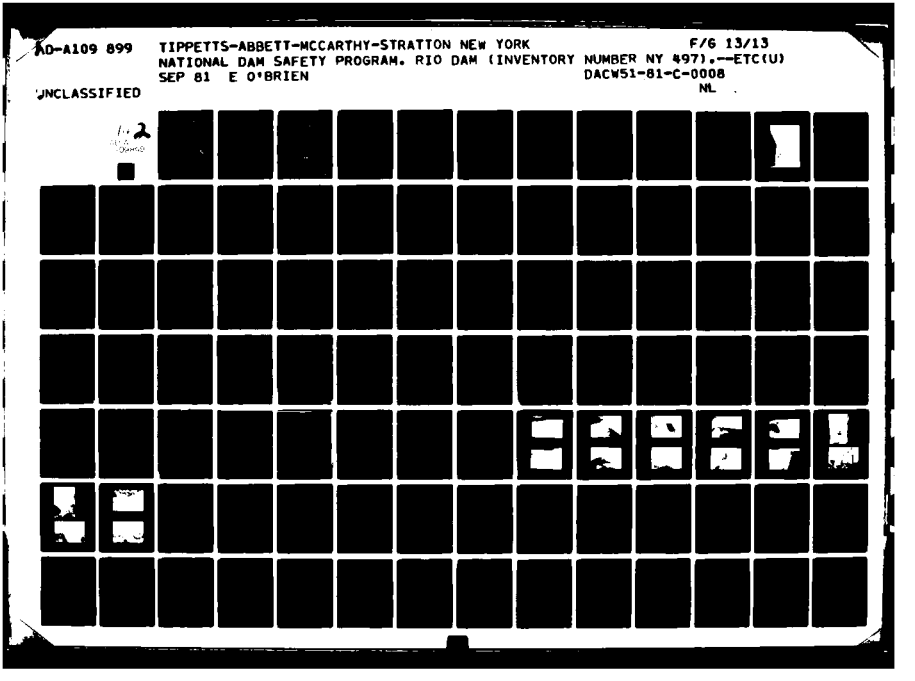


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Delaware River Basin, Orange County, NY
Inventory 497

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National Dam Safety Program

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Orange County
Delaware River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Examination of available documents and a visual inspection of the dam and the appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

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Using Corps of Engineers' Screening Criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 57.7 percent of Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as "inadequate".

Structural stability analyses performed, based on available information and visual inspection indicate that the spillway section is inadequate with respect to overturning and sliding stability, when subjected to ½ PMF or PMF loading conditions. The basis for this determination of inadequacy are criteria established by the Corps of Engineers (Ref. 1).

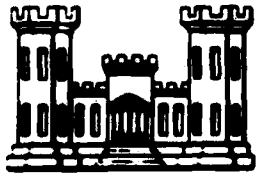
In addition, the nature and sources of seepage waters present at the downstream toe of the dam need to be further investigated.

DELAWARE RIVER BASIN

RIO DAM

ORANGE COUNTY, NEW YORK
INVENTORY NO. N.Y. 497

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1981

4 DELAWARE RIVER BASIN

2 RIO DAM

ORANGE COUNTY, NEW YORK

3 INVENTORY NO. N.Y. 497

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NEW YORK DISTRICT CORPS OF ENGINEERS

SEPTEMBER 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
RIO DAM
I.D. NO. N.Y. 497
D.E.C. NO. 149B - 86
DELAWARE RIVER BASIN
ORANGE AND SULLIVAN COUNTIES, NEW YORK

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	Rio Dam (I.D. No. N.Y. 497)
STATE LOCATED:	New York
COUNTY LOCATED:	Orange and Sullivan
STREAM:	Mongaup River
BASIN:	Delaware River
DATE OF INSPECTION:	8 July 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam and the appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

Using Corps of Engineers' Screening Criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 57.7 percent of Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as "inadequate".

Structural stability analyses performed, based on available information and visual inspection indicate that the spillway section is inadequate with respect to overturning and sliding stability, when subjected to ½ PMF or PMF loading conditions. The basis for this determination of inadequacy are criteria established by the Corps of Engineers (Ref. 1).

In addition, the nature and sources of seepage waters present at the downstream toe of the dam need to be further investigated.

It is, therefore, recommended that within 3 months of notification to the owner, investigation and analysis of embankment stability with respect to seepage should be performed. The results of this investigation and analysis will determine the appropriate remedial measures which will be required. In the interim, continued use of the present Emergency Action Plan and Periodic Inspection Practice will be sufficient to monitor the facility during periods of heavy rainfall.

In addition, the dam has a number of problem areas which require further attention. The following remedial measures must be completed within one year:

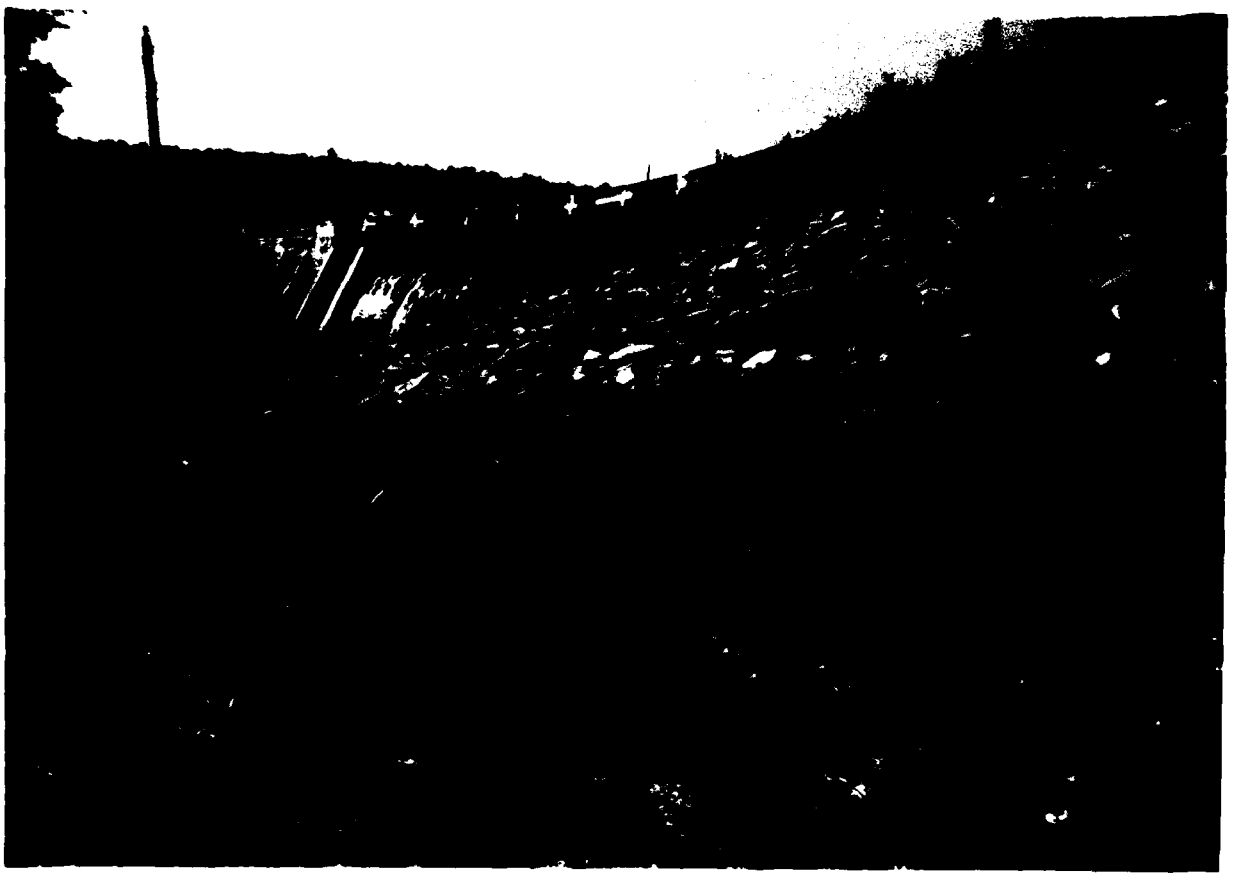
- Repair distressed areas of wood stave penstock to facilitate its future use as an emergency reservoir drain system.
- Remove small bushes, brush and trees growing on both downstream and upstream embankment slopes.
- Monitoring of seepage using the existing weir systems should be continued.

Eugene O'Brien, P.E.
New York No. 29823

Approved By:

Col. W. M. Smith, Jr.
New York District Engineer

Date: 14 Sep 81



1. OVERVIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
RIO DAM
I.D. NO. N.Y. 497
D.E.C. NO. 149B - 86
DELAWARE RIVER BASIN
ORANGE AND SULLIVAN COUNTIES, NEW YORK

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

The Phase I inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers Contract No. DACW 51-81-C-0008, Modification P00001 in fulfillment of the requirements of the National Dam Inspection Act, Public Law 92-367, dated 8 August 1972.

b. Purpose of Inspection

This inspection was conducted to evaluate the existing condition of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property and to recommend remedial measures where required.

1.2 DESCRIPTION OF THE PROJECT

a. Description of Dam and Appurtenant Structures

The Rio Dam is an earthfill embankment with a concrete overflow section located about mid-length along the 1,487 foot long structure. The maximum height of the dam at the overflow section is 101 feet. The embankment portion of the structure is a zoned fill. The central core is composed of sandy clay and has a top width of about 10 feet, side slopes of 2 Vertical to 1 Horizontal (2V:1H) and extends into an impervious foundation stratum. The outer shell of the embankment is constructed of sand, gravel and boulder fill using slope ratios of 1V:3H on the upstream and 1V:2H on the downstream. Crest of the dam is 20 feet wide and serves as a public roadway. Random stone riprap covers the entire upstream slope of the dam whereas only portions of the downstream slope within the lateral extent of the spillway abutment walls are similarly protected.

An intake having an invert at El 769.5 is located at the right spillway abutment to supply flow through an 11.0 foot diameter wood stave penstock to a small hydroelectric generating station located about 1.5 miles downstream of the dam. It is

reported that some segments of the penstock are damaged and therefore it has not been in use for the past 2 years.

The centrally located spillway section of the dam is a concrete gravity structure 264 feet in length, having a maximum height of 101 feet. Overflow is concrete through eight 30 foot wide bays separated by 3 feet wide piers which support a roadway bridge deck. Flow is controlled using flashboards; to a maximum design height of 5 feet. The flashboard system is designed to release when lake levels reach 2 feet above the top of flashboards. The dam has no reservoir drain. If repaired, the penstock could be used to partially drain the reservoir.

b. Location

The Rio Dam is located on the Mongaup River, a tributary of the Delaware River, about 1.5 miles northwest of the town of Rio and about 13 miles south-southwest of the City of Monticello, on the border of Sullivan and Orange Counties, New York.

c. Size Classification

The dam is 101 feet high and has a reservoir storage capacity of 19,978 acre-feet and, therefore, is classified as a large dam.

d. Hazard Classification

The dam is in the "high" hazard potential category due to location of a hydroelectric generating station and the village of Mongaup, 1.5 miles and 4 miles downstream, respectively.

e. Ownership

The dam is owned and operated by Orange and Rockland Utilities Inc., One Blue Hill Plaza, Pearl River, N.Y. 10965, Tel Nos. (914) 627-2420 or (914) 352-6000. Prime contacts are Mr. Frank E. Fischer; Vice President and Mr. Donald Lavers, Supervisor-in-charge of Engineering.

f. Purpose

The dam provides storage for hydroelectric power development. Presently and over the past two years, power has not been generated at the facility. Recreation is permitted on the lake except at the southern end where the dam is located.

g. Design and Construction

The dam was designed by Charles H. Tenney & Co., 200 Devonshire Road, Boston, Massachusetts in 1925. The dam

was constructed between 1926 and 1927 by Fred T. Ley, Inc., General Contractor, Boston, Massachusetts. Resurfacing of both the spillway chute and roadway have been performed in recent years by the owner.

h. Normal Operating Procedures

Discharge through the spillway is presently controlled with two flash boards to El 811.2 present in the 5 western most spillway bays whereas single boards to El 810.67 are present in the remaining 3 eastern bays. Since the power unit associated with Rio Dam is presently not on line, the flow from the reservoir is regulated over the spillway by using the flashboards as a function of discharge from Swinging Bridge Dam and Toronto Dam, located upstream in order to maintain a relatively constant lake level for recreational purposes.

1.3 PERTINENT DATA

a. Drainage Area	202	square miles
b. Discharge at Damsite cfs		
Uncontrolled Spillway at Maximum Pool (El. 825.00)	62,090	cfs
c. Elevation, USGS Datum MSL		
Maximum Pool, Top of Dam	825.00	feet
Maximum Design Pool	822.00	feet
Spillway: Crest	810.00	feet
Top of Flashboard (designed)	815.00	feet
Invert Penstock Inlet	769.50	feet
d. Reservoir		
Length of Maximum Pool	3,910	feet
Surface Area @ Maximum Pool	542	acres
e. Storage		
Normal Pool	13,110	acre-feet
Maximum Pool	19,978	acre-feet

f. Dam

Type	Earthfill w/concrete spillway section
Height	101 feet
Length	1,487 feet
Upstream Slope	1V:3H
Downstream Slope	1V:2H
Crest Elevation	825.00 feet
Crest Width,	20 feet
Cut Off Type	Penetrating clay core in earthfill section; shallow concrete wall in spillway section
Grout Curtain	None

g. Spillway

Type	Controlled "ogee" concrete gravity structure
Crest Elevation	810.00 feet
Width: Total:	264 feet (total)
Effective:	240 feet (hydraulic)
Flow Regulation	Flashboards (5 feet maximum)

h. Reservoir Drain

Type	None

i. Penstock System

Intake invert elevation	769.5 feet
Pipe Construction	Steel/Wood Stave
Pipe Diameter	11.0 feet

SECTION 2 - ENGINEERING DATA

2.1 GEOLOGY

The Rio Dam is located in the "Appalachian Uplands" Physiographic province of New York State. This province (northern extreme of the Appalachian Plateau) was formed by dissection of the uplifted but flat lying sandstones and shales of the middle and upper Deconian Catskill Delta. Relief is high to moderate. Maximum dissection occurs in the Catskill Mountain area, where only the mountain peaks approximately the original plateau surface. Drainage is generally south or southwest toward the Delaware River system. Bedrock which out crops at the river bed near the toe of the spillway is a fine grained sandstone dipping about 5-10 degrees to the north. Strike is to the west and estimated to be 5-10 degrees.

2.2 SUBSURFACE INVESTIGATIONS

A subsurface investigation was conducted. The results of the investigation are presented in conjunction with the available design drawings in Appendix A - Drawing KK-3-52. In general, the investigation indicated that the soils at the site are alluvial in the lower river area, whereas the near surface soils in the upland portions of the valley are primarily of glacial origin being composed of clay, sand and gravel with occasional zones of boulders. Underlying bedrock consists of interlayered sandstone and shales.

2.3 DAM AND APPURTENANT STRUCTURES

The dam was designed by Charles H. Tenney & Co., 200 Devonshire Road, Boston, Masaachusetts. All drawings available for review have been reproduced and are presented as one-half size reductions in Appendix A.

2.4 CONSTRUCTION RECORDS

No information regarding the construction of the dam is available, other than the date of construction, which is from 1926 to 1927, and the name of the contractor, Fred T. Let, Inc., Gunnite resurfacing of the spillway chute and apron and reconstruction of the roadway were performed during the 1970's by the owner.

2.5 OPERATING RECORDS

All information concerning operation and maintenance of the dam is on file at the Orange and Rockland Operations and Generating Center in Spring Valley, New York.

2.6 EVALUATION OF DATA

Some of the data presented in this report has been made available by representatives of Orange and Rockland Utilities Inc. All information gathered appears to be adequate and reliable for Phase I Inspection purposes.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection of the Rio Dam was made on July 8, 1981. The weather was clear with temperatures ranging in the mid to high 90's. The reservoir level at the time of inspection was about El 811.20.

b. Embankment

The earth embankment shows no signs of noticeable distress. Both vertical and horizontal alignments of the structure show no signs of noticeable movement. Occasional small bushes, trees, and brush have become established on both upstream and downstream slopes. Minor longitudenal hairline cracks were observed in the asphalt roadway pavement surface.

c. Spillway

The spillway chute and apron appears generally in good structural condition. Minor longitudinal cracks exhibited along the chute appear to be associated with construction joints from the gunnite resurfacing. Minor spalling of the structure near downstream training walls was observed.

d. Seepage

Minor seepage was observed around the steel pipe at the head waters of the penstock as it exits the right spillway abutment. Seepage associated with a natural spring is flowing from the downstream left abutment and is collected into a small drainage ditch immediately downstream of the embankment toe. A wet marshy area at the toe of the dam was observed, approximately 20 feet northeast, at the end of the left spillway abutment. Source of surface water in the area appears to be seepage from the embankment toe. Seepage was also observed entering the spillway apron at the downstream left abutment (see photograph No. 15). Source of these waters may be a combination of bedrock groundwater, surface water runoff, and embankment seepage. Seepage waters observed in the vicinity of the toe of the dam were visibly free of suspended solids. Two weirs are located on the drainage ditches downstream of the embankment toe to facilitate measurement of collected seepage and surface water runoff. Approximate locations of these weirs are shown on the sketch which is included in Appendix C.

e. Appurtenant Structures

Gatehouse is in good condition. Penstock control valves are reported in good working order but were not operated during site inspection. Penstock is damaged and needs repair before it can be used in conjunction with power generation or partial drainage of the reservoir. Penstock gate valve has minor leak.

f. Downstream Channel

The spillway discharges directly into the natural rock channel of the Mongaup River. In the area immediately downstream of the dam (See Photograph 7) the channel is generally clear and unobstructed with the exception of a few fallen trees.

g. Abutments

The dam abutment areas are in good condition showing no signs of instability. Seepage waters are flowing from the bedrock, forming the left abutment immediately downstream of the dam.

h. Reservoir Area

No slides or general instability were observed along the reservoir shoreline in the general vicinity of the dam. No significant sedimentation was observed along the dam.

3.2 EVALUATION OF OBSERVATIONS

Although deficiencies were observed, there is no indication that the dam is in imminent danger. Some of the deficiencies noted previously are minor and should be corrected in conjunction with routine, whereas other conditions described, may present potential for further deterioration and consequently need for further investigation and correction.

The following is a summary of the problem areas encountered and recommended corrective measures requiring immediate attention:

1) Investigation nature and source of seepage waters present along the toe of the dam.

2) Repair distressed areas of wood stave penstock to facilitate its future use as an emergency reservoir drain system.

3) Remove small bushes, brush and trees growing on both upstream and downstream embankment slopes.

SECTION 4 - OPERATIONAL & MAINTENANCE PROCEDURES

4.1 PROCEDURES

The Rio Dam was previously used as a power generating dam for Orange and Rockland Utilities Inc. For the past two years the penstock has been closed as a result of a rupture in the wood stave section and no power generated. Previous operations included the operation of a single 11 foot diameter wood stave penstock to carry water from the reservoir to a power house located some 7,000 feet downstream. Flow is controlled by a sliding gate valve operated from the gatehouse atop the dam.

Spillway discharges as well as lake level is controlled using a system of flashboards located on the crest of the eight bay spillway

4.2 MAINTENANCE OF THE DAM

The dam is maintained by the owner, Orange and Rockland Utilities Inc. Maintenance is performed on an as-needed basis as determined by frequent inspections. Maintenance of the dam appears to be adequate with the exceptions as noted in "SECTION 4 - EVALUATION".

4.3 WARNING SYSTEM IN EFFECT

It is reported that an Emergency Action Plan (EAP) has been developed by the owner to monitor the three hydroelectric facilities located on the Mongaup River including the Rio Dam. Within this EAP a procedure for continual monitoring and reporting of flood level conditions is stated with procedures for notification of various public authorities in the event an emergency situation develops.

4.4 EVALUATION

Both the maintenance and operation procedures are inadequate in following areas:

1) Vegetation on both upstream and downstream embankment slopes.

2) Penstock is inoperable.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

Rio Dam is located on the Mongaup River about 5 miles north of its junction with the West Branch Delaware River at Mongaup, Sullivan County, New York (HUC#02040104). The drainage area contributing to the reservoir is 202 square miles. The basin is approximately 25 miles along the north-south axis, with a maximum width of about 11 miles. The basin contains many lakes and reservoirs in addition to Rio Reservoir, and rises from a normal lake elevation of 810 MSL (invert of spillway) to over 2,200 ft in the north. Ground cover ranges from urban areas to national forest and includes farm lands, and wet lands.

5.2 ANALYSIS CRITERIA

The unit hydrographs and modeling parameters for the watershed, divided into 3 sub-areas were obtained from the "Upper Delaware River Basin Flood Routing Model"(Ref.2),prepared in 1976 by Water Resources Engineers Inc. (WRE), for the New York District of the U.S. Army Corps of Engineers. This model computed the Standard Project Flood for the entire watershed. The Rio Dam drainage area consists of sub-basins 49, 50 and 51 of the Delaware River basin model.

The Probable Maximum Precipitation for the Rio Dam watershed is 21-inches(Ref.3). The Probable Maximum Flood hydrograph was computed using the HEC-1DB computer package(Ref.4). It was necessary to extend the storage discharge rating of Swinging Bridge Dam to meet the PMF flows.

A total PMF inflow based on the combined output of Swinging Bridge Dam, Toronto Dam and the runoff contribution of the Rio Dam watershed was calculated to be 107,744 cfs was used for analysis.

5.3 SPILLWAY CAPACITY

The computed discharge capacities of the spillway at low chord of the roadway bridge, El 823.9 and at the top of dam, El 825 are 51,242 cfs and 62,090 cfs, respectively.

5.4 RESERVOIR CAPACITY

The reservoir capacity at the spillway crest, El 810, is given as 13,110 acre-feet (Ref.2). The computed surcharge storage of 6,868 acre-feet is equivalent to about 0.6-inches of runoff over the entire watershed.

5.5 FLOODS OF RECORD

Maximum flood was reported to be in August 1955. Records reservoir levels during this flood are the files of the owner.

5.6 OVERTOPPING POTENTIAL

The potential of the dam being overtopped was investigated on the basis of the spillway discharge capacity and the available surcharge storage to meet the combined PMF inflows.

Two cases were evaluated using the HEC-1DB analysis; Case A) flood build-up with no flashboards in place at the beginning of the PMF; and Case B) flood stage build-up with flashboards in place to El 815 at the beginning of the routing with safety release as water builds up to El 817.

During the flood series analyses the penstock gate was assumed to be closed and flashboards at the Toronto Reservoir were assumed absent. The results of the two Multi-Ratio Case analyses are as follows:

Case A
No Flashboards at Rio Dam

Ratio of PMF	Peak Outflow (cfs)	Overtopping (ft)
1.0	107,523	4.69
0.75	79,675	2.28
0.50	51,090	0.00
0.25	24,389	0.00

Case B
Flashboards to El 815 At Beginning of Flood

Ratio of PMF	Peak Outflow (cfs)	Overtopping (ft)
1.0	107,525	4.69
0.75	79,676	2.28
0.50	51,089	0.00
0.25	24,386	0.00

The maximum spillway discharge capacity (water surface at El 825) of 62,090 cfs is 57.7% of the peak PMF outflow.

5.7 EVALUATION

The spillway is unable to pass the PMF without the dam being overtopped, and is assessed as being "inadequate".

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Visual observations do not indicate conditions which would adversely affect the structural stability of the dam. The observed seepage at the embankment is not considered detrimental to the stability or safety of the dam at the present time.

b. Design and Construction Data

Design drawings prepared by Charles H. Tenney and Co. Engineers, Boston, Mass. were provided by the owner and provided the basis for stability evaluations. Data regarding the construction history of the structures was not available.

c. Operating Records

No major operational problems which would affect the stability of the dam were reported.

d. Post-Construction Changes

A complete resurfacing of the spillway chute and apron was performed in 1971 as a result of significant spalling. Reconstruction of the roadway spanning the crest was performed in 1979.

e. Seismicity

According to the guidelines and criteria set forth by the Corps of Engineers (Ref. 1) the dam is located in a Zone 1 seismic area.

6.2 STRUCTURAL STABILITY ANALYSIS

Structural stability of the concrete overflow section was evaluated. The method of analysis and stability criteria, were in accordance with EM 1110-2-2200 published by the Corps of Engineers, U.S. Army. Assumptions and calculations for the analyses are included in the Appendix D, and summarized as follows:

Case	Loading Condition	Location of Resultant	Sliding F.S.
I.	Normal loading condition, reservoir level at spillway crest, no ice load	within middle one third	3.19
II.	Normal loading condition, reservoir level at spillway crest, with ice load	within middle one third	3.13
III.	Unusual loading: flood level equal to ½ PMF at maximum overflow section	7.53 ft outside middle one third	2.60
IV.	Extreme loading: flood level equal to PMF at the maximum overflow section	14.16 ft outside middle one third	2.02

The results of the stability analysis indicate that stability of the maximum overflow section of the dam against overturning is inadequate for both ½ PMF and PMF loading conditions. In both cases the resultant forces are located outside the middle one third of the base width and factors of safety against sliding are less than 3.0. These conditions are not consistant with the minimum criteria set forth by the Corps of Engineers(Ref.1) and, therefore, the dam is considered inadequate for ½ PMF and PMF conditions.

SECTION 7 - ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety

Examination of the available documents and a visual inspection of the dam and the appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property. However, the dam has some deficiencies which require further investigation and remedial action.

Using the Corps of Engineers' Screening Criteria (Ref. 1) for review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 57.7 percent of the Probable Maximum Flood (PMF). The spillway is, therefore, adjudged as "inadequate".

Structural stability of the dam based on available information and visual inspection is inadequate under Corps of Engineers Criteria for both ½ PMF and PMF loading conditions. Resultant forces for these two conditions fall outside the middle one third of the base width with factors of safety against sliding being less than 3.0.

b. Adequacy of Information

The information and data available were adequate for performance of this investigation.

c. Need for Additional Investigation

Investigation to determine source of surface waters at the toe of the dam (left side of spillway) and their potential indication of embankment seepage should be undertaken to provide data for more detailed seepage analyses.

d. Urgency

The additional investigation recommended should be initiated within 3 months from the date of notification. Within 18 months of notification, remedial measure as a result of these investigations must be initiated, with completion of these measures during the following year.

7.2 RECOMMENDED MEASURES

1. The results of the aforementioned analyses will determine in the appropriate remedial measures required.

2. Repair distressed areas of wood stave penstock to facilitate its further use as an emergency reservoir drain system.

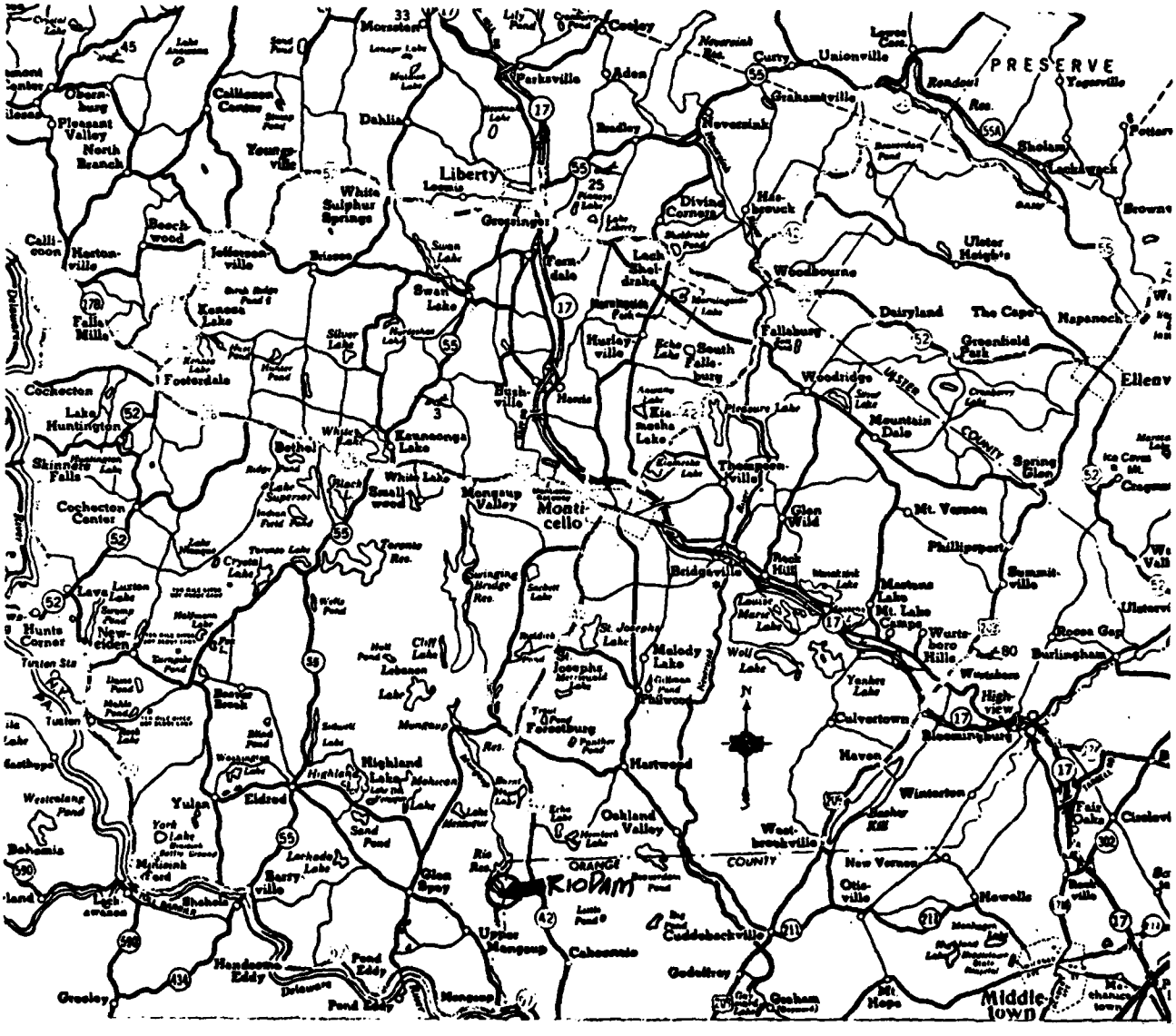
3. Remove small bushes, brushes and trees growing on both upstream and downstream embankment slopes.

4. Monitoring of seepage using the existing weir systems should be continued.

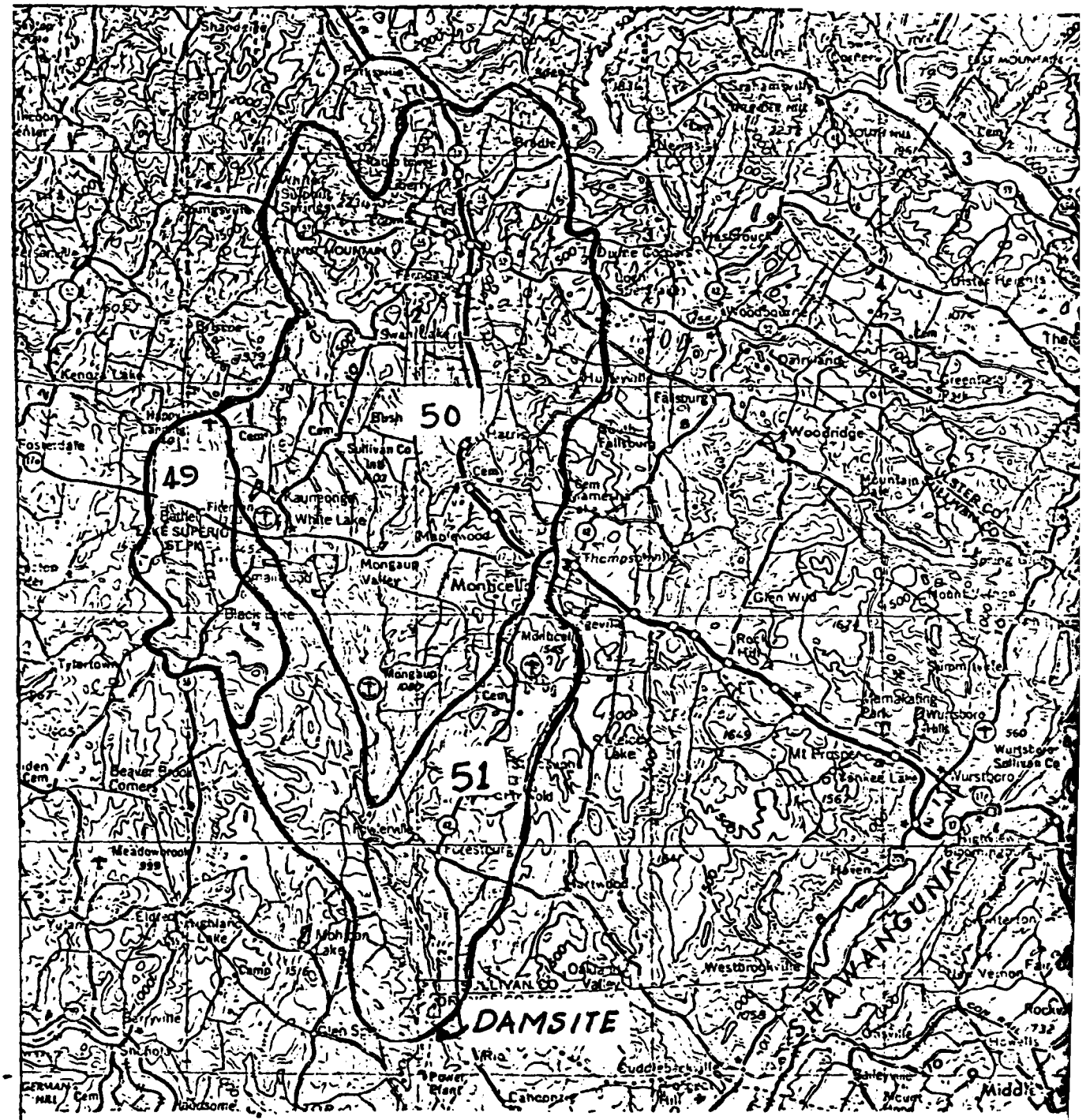
DRAWINGS

DWG. NO. KK-3-50:	Stress Sheet Spillway,Section of Dam
DWG. NO. KK-3-51A:	General Plan
DWG. NO. KK-3-52:	Borings
DWG. NO. KK-3-53:	General Plan of Dam
DWG. NO. KK-3-54:	General Plan, Abutment Walls of Dam
DWG. NO. KK-3-55:	General Plan, Spillway Section of Dam
DWG. NO. KK-3-56:	Sections Abutment Walls of Dam
DWG. NO. KK-3-57:	Details of Bridge over Dam
DWG. NO. KK-3-58:	Intake, General Plan

APPENDIX A



VICINITY MAP
RIO DAM



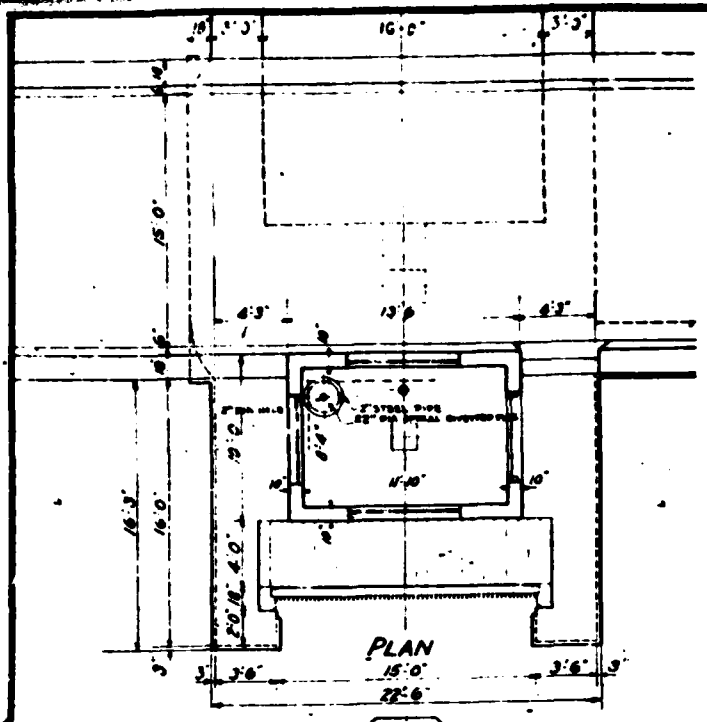
CONTOUR INTERVAL 100 FEET

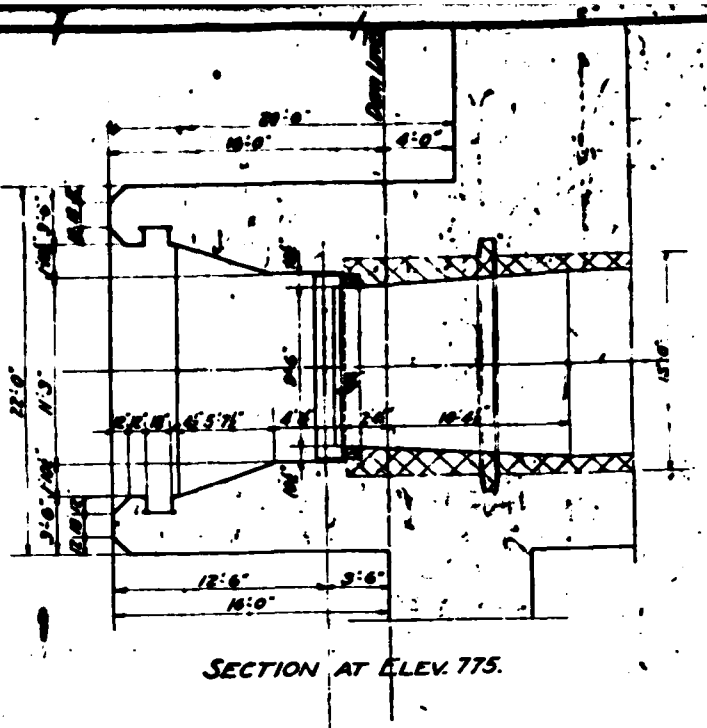
TRANSVERSE MERCATOR PROJECTION

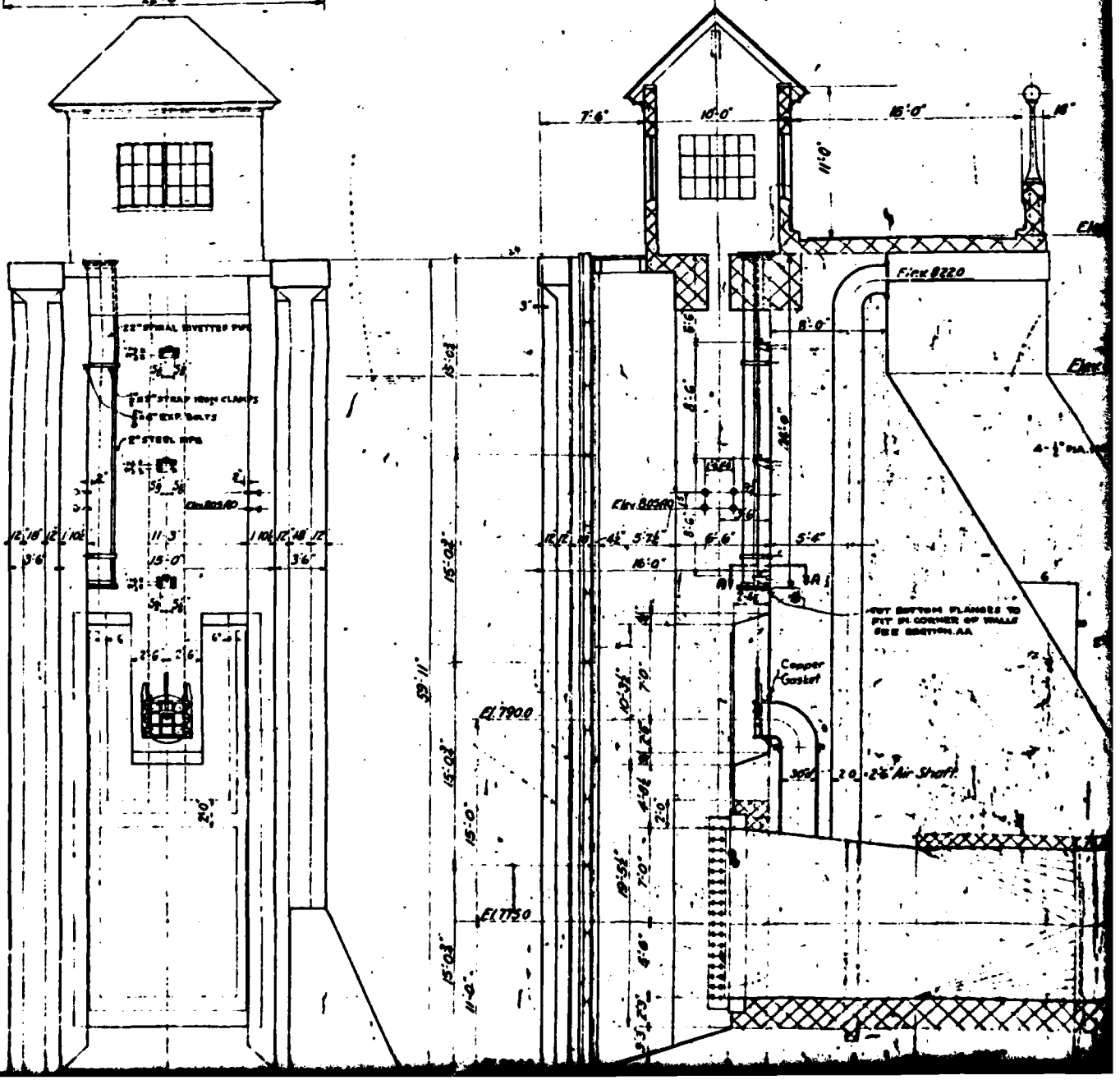
BLACK NUMBERED LINES INDICATE THE 10,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID, ZONE 18

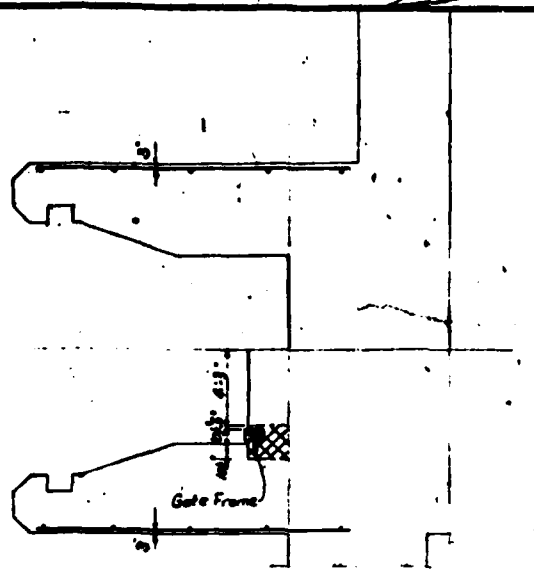
1985 MAGNETIC DECLINATION FROM TRUE NORTH VARIES FROM 9° (160 MILS) WESTERLY FOR THE CENTER OF THE WEST EDGE TO 11° (200 MILS) WESTERLY FOR THE CENTER OF THE EAST EDGE

FOR SALE BY U S. GEOLOGICAL SURVEY, RESTON, VIRGINIA 22092


PLAN


SECTION AT ELEV. 775.

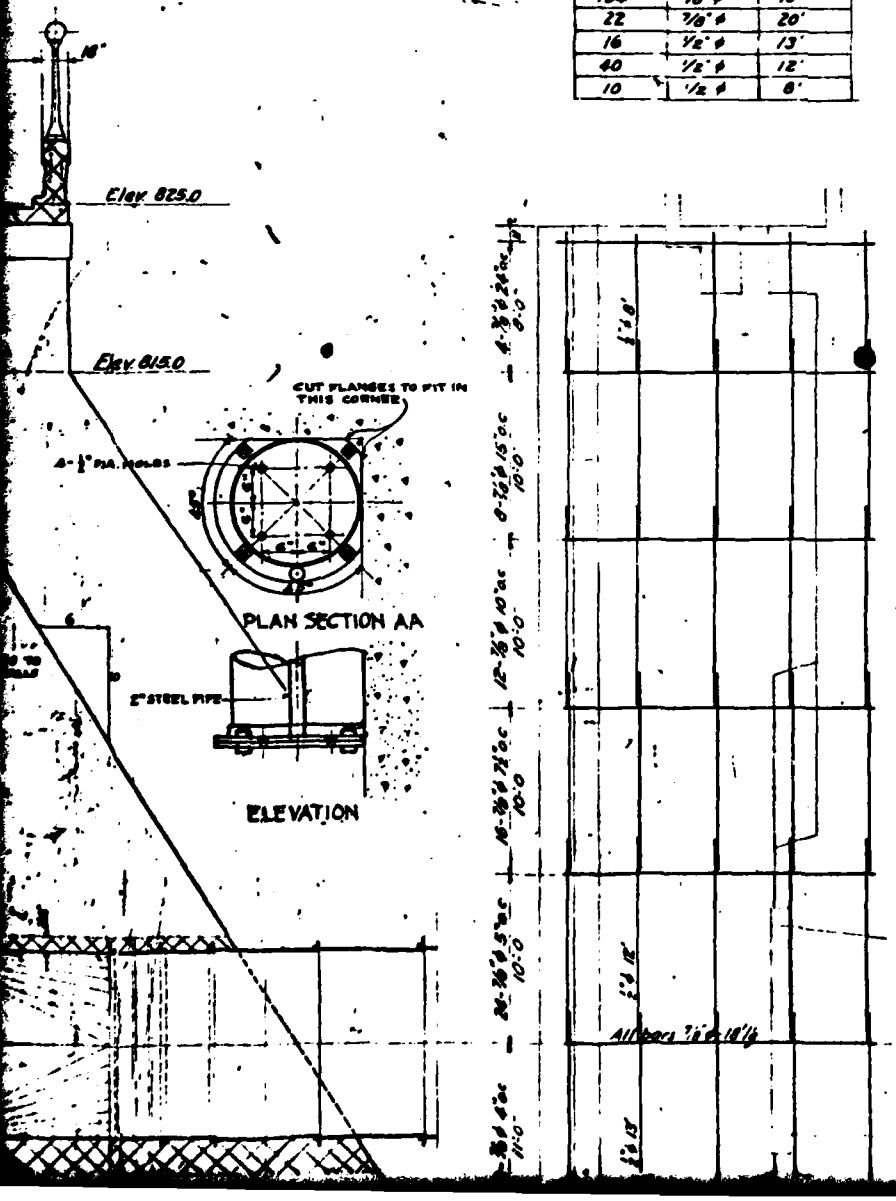

Elev. 822.0
Elev. 805.80
Elev. 790.0
Elev. 775.0
Copper Gasket
Air Shaft



SECTIONS SHOWING REINFORCEMENT

SCHEDULE

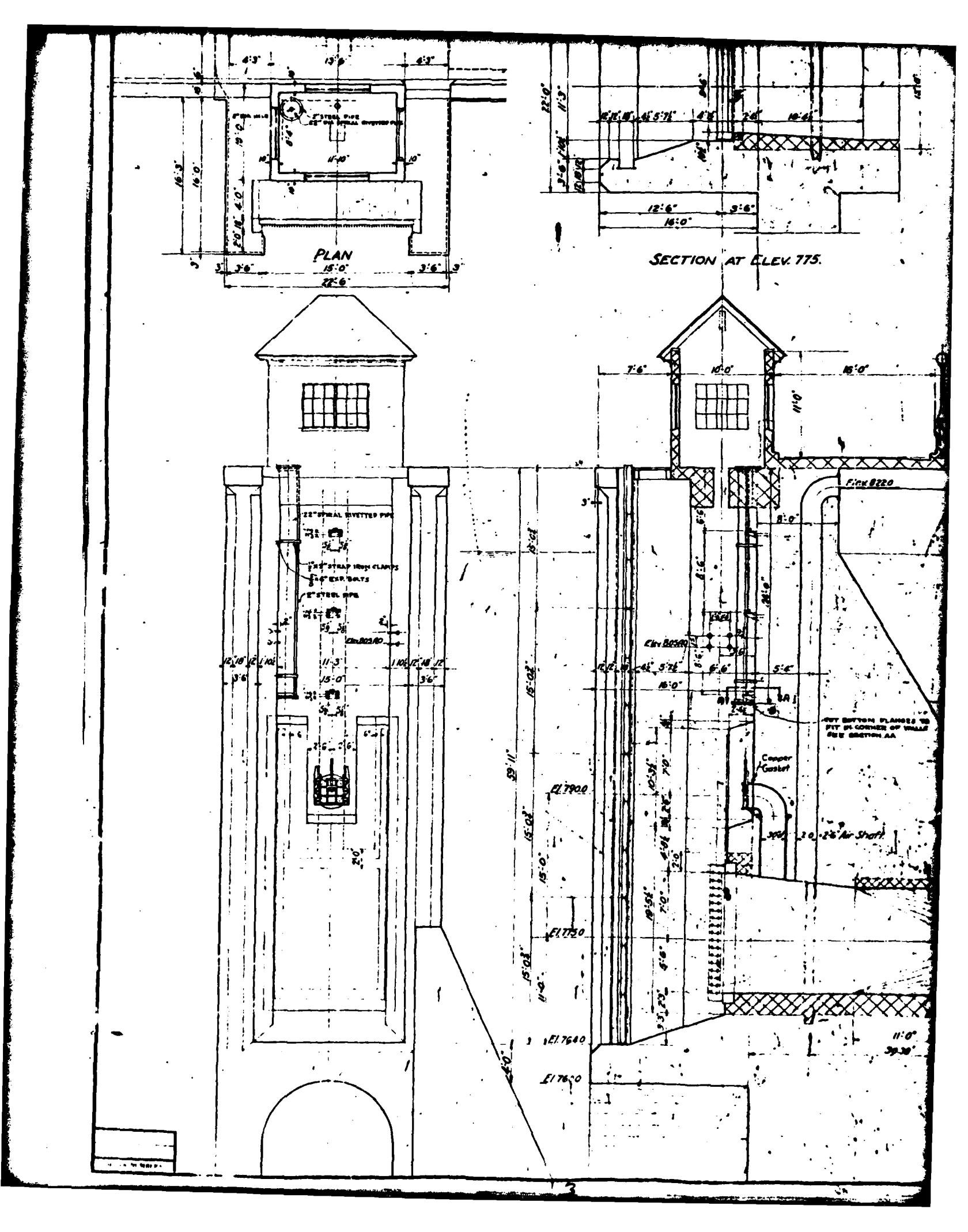
NUMBER	SIZE	LENGTH
194	7/8" ϕ	18'
22	7/8" ϕ	20'
16	1/2" ϕ	13'
40	1/2" ϕ	12'
10	1/2 ϕ	8'

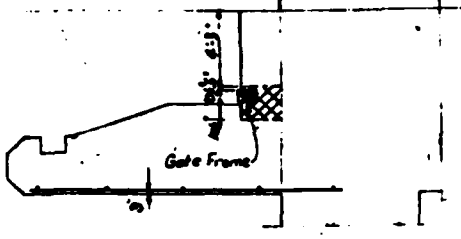


1:2:4 P.C.C.

APPROVED:
CHAS. T. MAIN, CONSULTING ENGR,
200 DEVONSHIRE ST.,
BOSTON, MASS.

Chas. T. Main


PLAN
SECTION AT ELEV. 775.
22" SPIRAL RIVETTED PIPE
Elev. 805.60
Elev. 822.0
Copper Gasket
EL 790.0
EL 775.0
EL 764.0
EL 760.0
2'-2" Air Shaft



SECTIONS SHOWING REINFORCEMENT

SCHEDULE

NUMBER	SIZE	LENGTH
194	7/8" ϕ	18'
22	7/8" ϕ	20'
16	1/2" ϕ	13'
40	1/2" ϕ	12'
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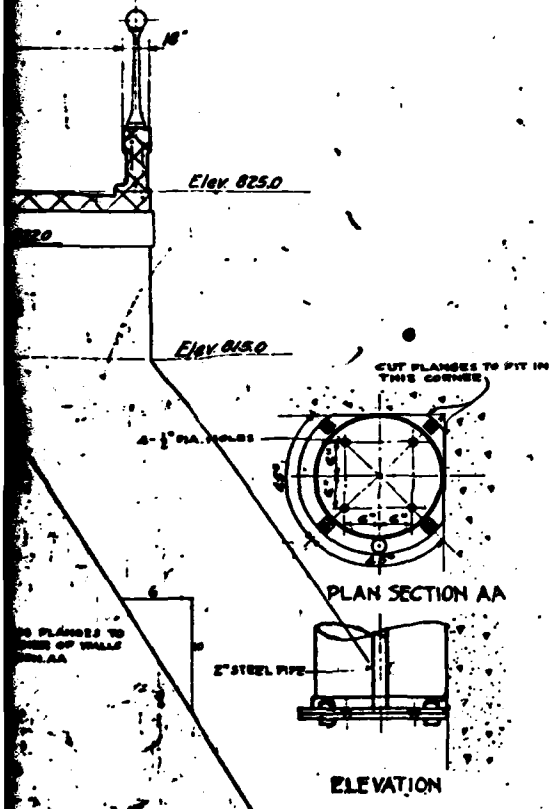
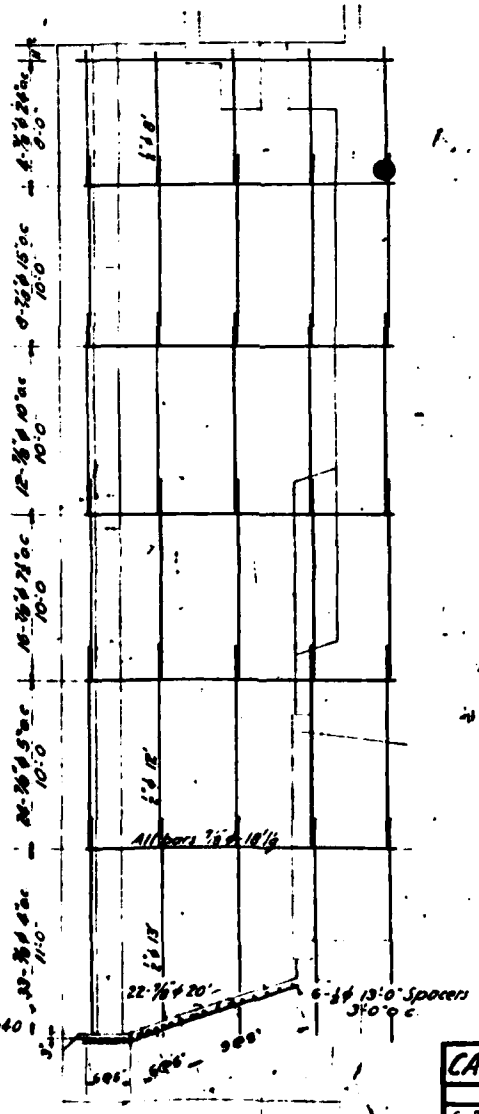




1:2:4 P.C.C.

APPROVED:
CHAS. T. MAIN, CONSULTING ENGR.,
200 DEVONSHIRE ST.,
BOSTON, MASS.
By Chas. T. Main

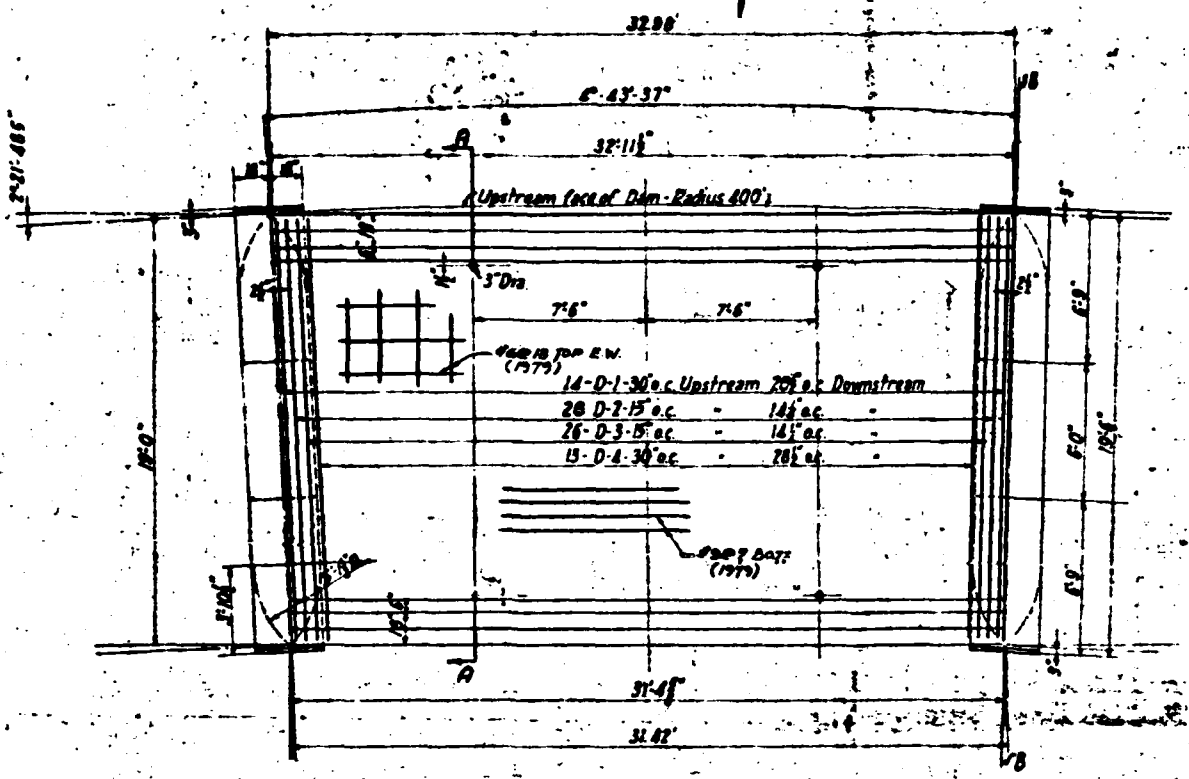
CATSKILL POWER CORP MIDDLETOWN N.Y.

REVISIONS

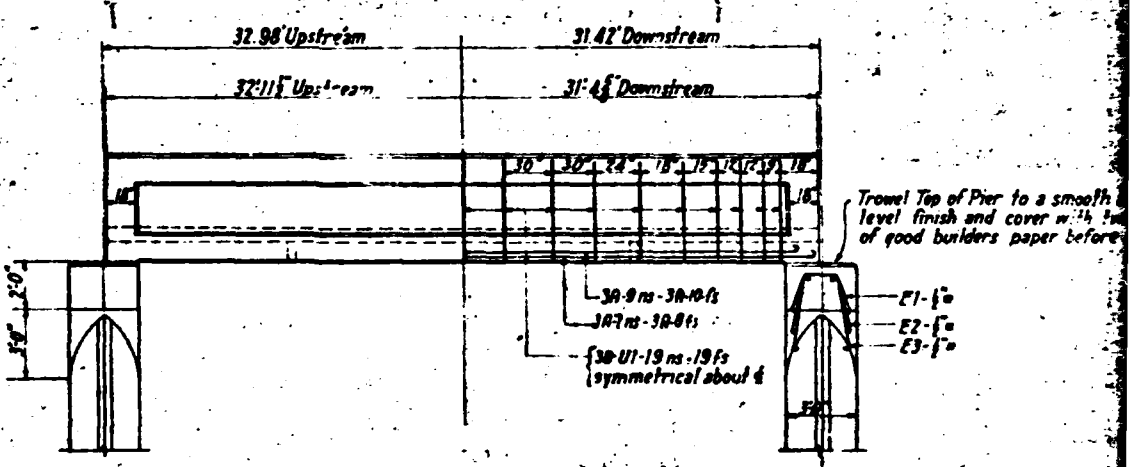
RIO DEVELOPMENT
INTAKE
GENERAL PLAN

PREPARED BY CHARLES H. TENNEY & ENGINEERS BOSTON MASS.

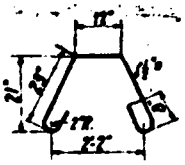
KK 3



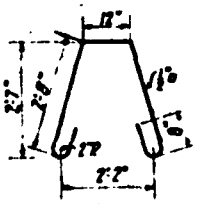
PLAN
Scale ½"-1'-0"
8 Spans like this. See Drwg KK-3-55

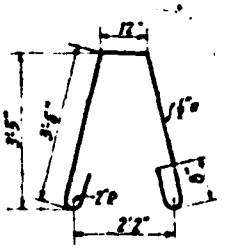


ELEVATION
Scale ½"-1'-0"



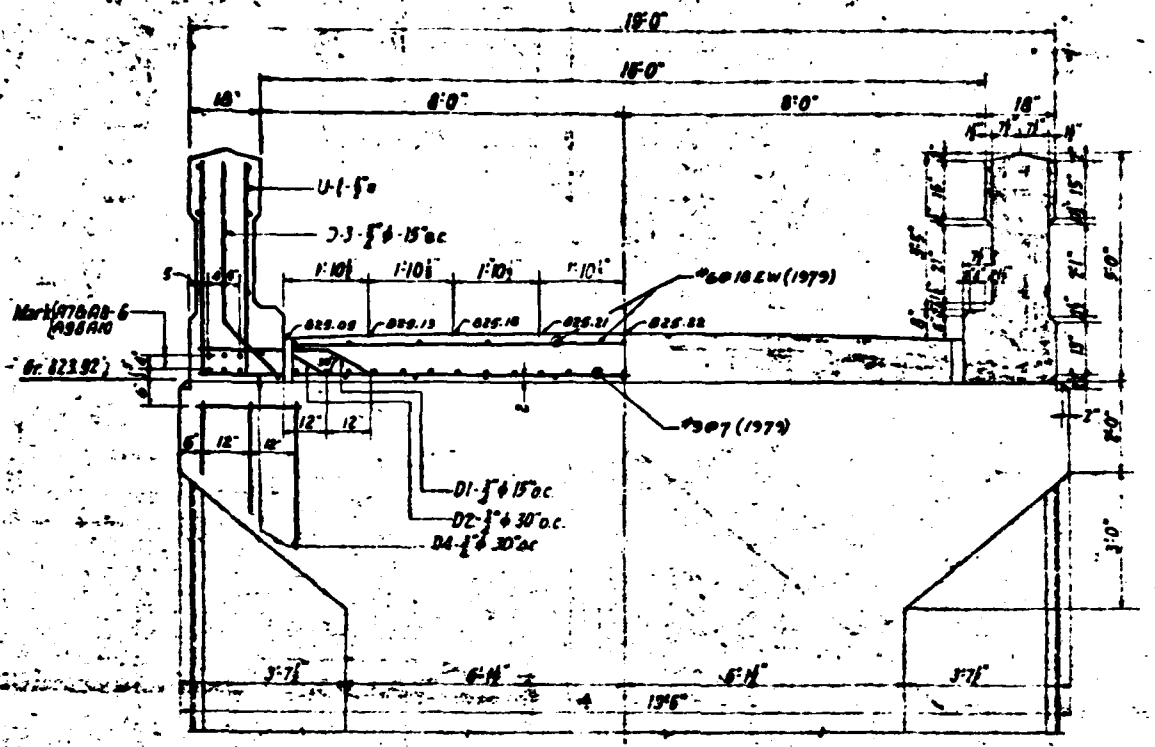
MAKE 18 - MARK E1



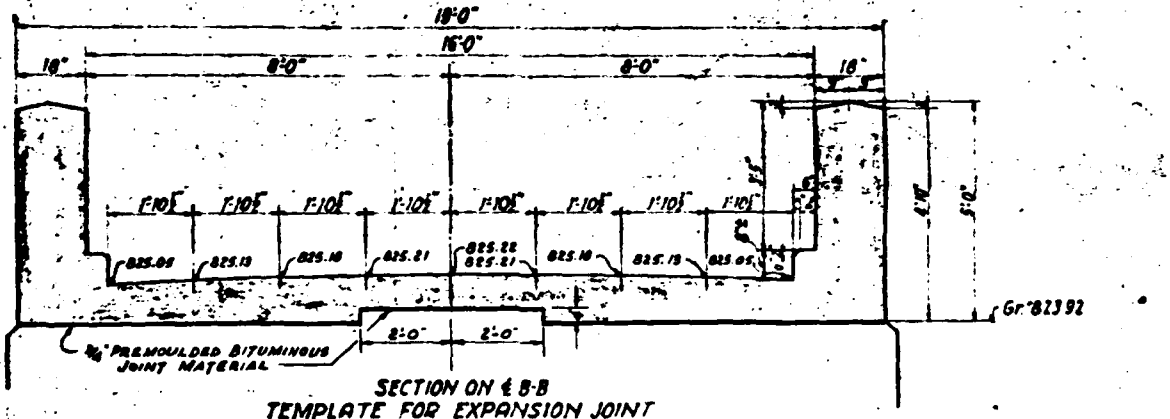


SCHEDULE OF SPACERS

Dia.	Length	Quantity
[0"	2'-9"	36
[0"	31'-0"	56
[0"	32'-6"	56
[0"	31'-0"	8
[0"	31'-3"	18
[0"	31'-6"	16
[0"	31'-9"	16
[0"	32'-0"	16
[0"	32'-3"	16



SECTION AA
Scale ⅜" = 1'-0"



SECTION ON ℄ B-B
TEMPLATE FOR EXPANSION JOINT
Scale ⅜" = 1'-0"

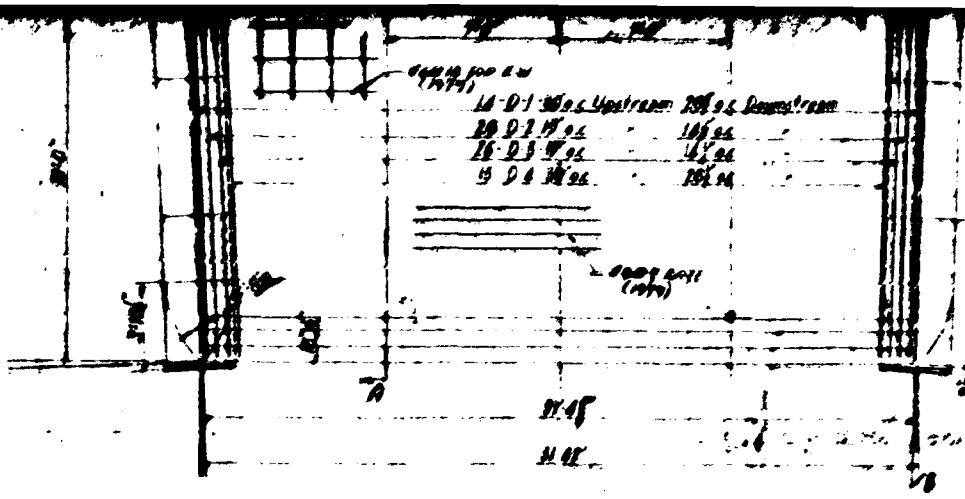
...de a smooth and ...ver with two layers ...paper before pouring bridge.

NOTE
Bridge floor and railings to be 1:2:4 concrete (2000#)
Bridge piers to be 1:2½:5 concrete
See KK-3-118 for LIGHTING CONDUITS IN BRIDGE.

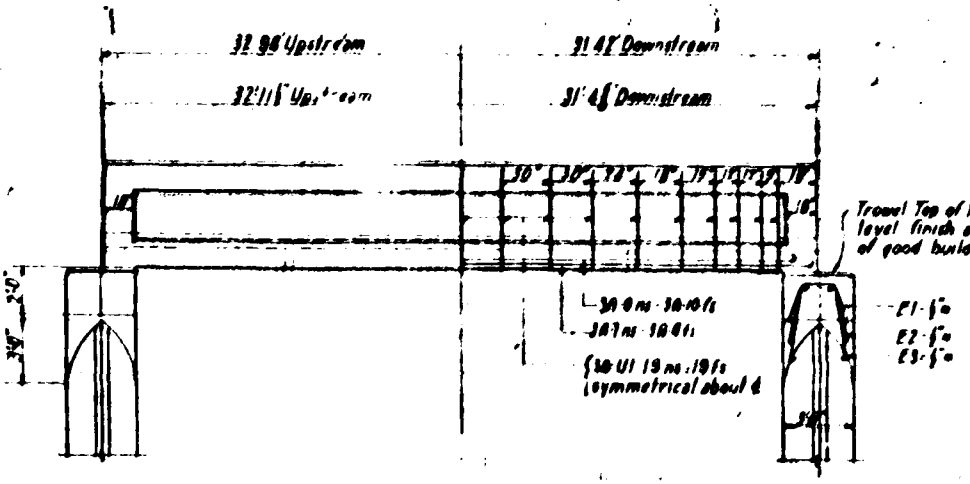
SCHEDULE OF BENT BARS

Mark	Dia	Length	Qty.	Detail
A7	⅞"	34'-6"	24	31'-0"
A8	1⅛"	36'-0"	24	32'-0"
A9	1⅛"	37'-6"	24	33'-0"
A10	1⅛"	39'-0"	24	34'-6"
D1	⅝"	18'-11"	112	1'-0" 15'-0"
D2	½"	16'-8"	208	15'-0"

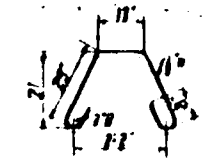
APPROVED
CHAS T MAIN CONSULTING ENGINEER
200 DEVONSHIRE STREET
BOSTON MASS.



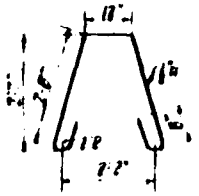
PLAN
Scale 1/8"-1'-0"
8 Spans like this See Drwg KK-3-55



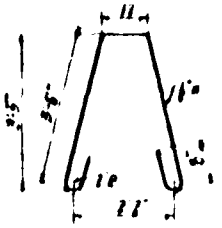
ELEVATION
Scale 1/8"-1'-0"



MAKE 18 MARK E1



MAKE 18 MARK E2

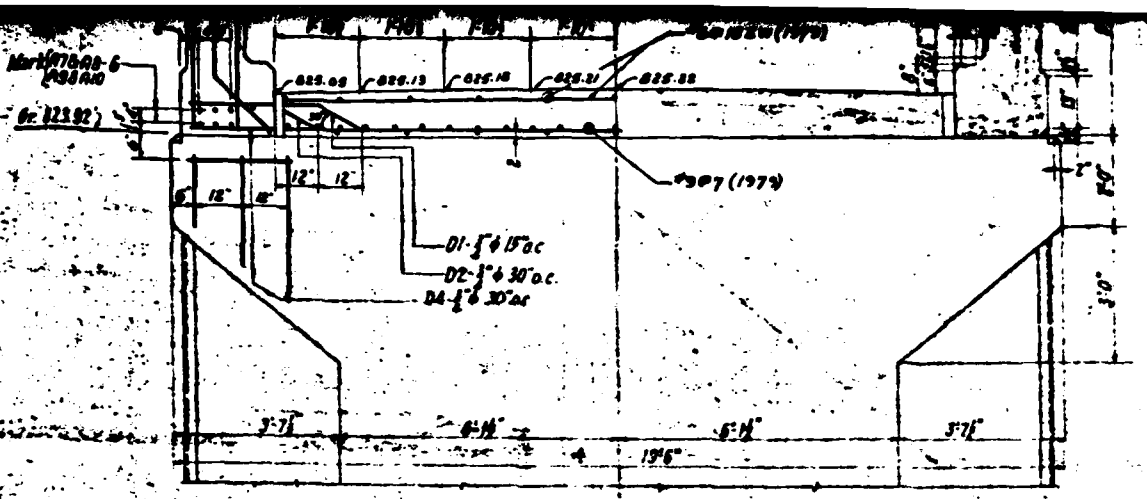


MAKE 18 MARK E3

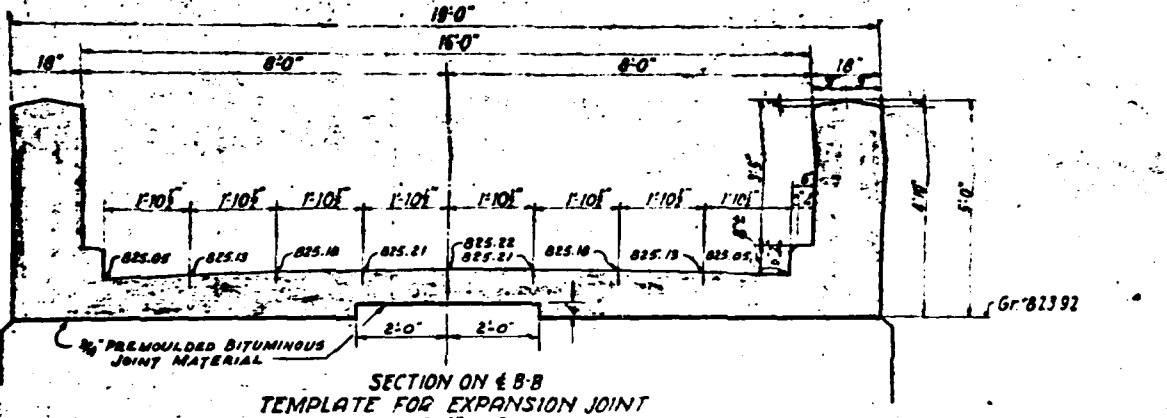
SCHEDULE OF SPACERS

Dia	Length	Quantity
1"	2'9"	36
1"	31'0"	56
1"	32'6"	56
1"	31'0"	8
1"	31'3"	16
1"	31'6"	16
1"	31'9"	16
1"	32'0"	16
1"	32'3"	16

Mark
A1
A8
A8
A8
D1
D2
D3
U1
D4
A8



SECTION AA
Scale ½" = 1'0"



½" PREMOULDED BITUMINOUS JOINT MATERIAL

SECTION ON ℄ B-B
TEMPLATE FOR EXPANSION JOINT
Scale ½" = 1'0"

...h smooth and
...with two layers
...er before pouring bridge.

NOTE
Bridge floor and railings to be 1:2:4 concrete (2500#)
Bridge piers to be 1:2½:5 concrete
See KK-3-118 for LIGHTING CONDUITS IN BRIDGE.

SCHEDULE OF BENT BARS

Mark	Dia	Length	Qty.	Detail
A7	1⅛"	34'6"	24	31'0"
A8	1⅛"	36'0"	24	32'6"
A9	1⅛"	31'6"	24	28'0"
A10	1⅛"	33'0"	24	29'6"
D1	½" ϕ	18'10"	112	2'9" 11'0" 2'9" 30"
D2	½" ϕ	18'10"	208	2'1" 15'0" 2'1" 30"
D3	½" ϕ	25'2"	208	17'6" 15'0" 45° 45°
U1	½" ϕ	10'0"	304	3'7" 10"
D4	½" ϕ	18'6"	104	18'6"

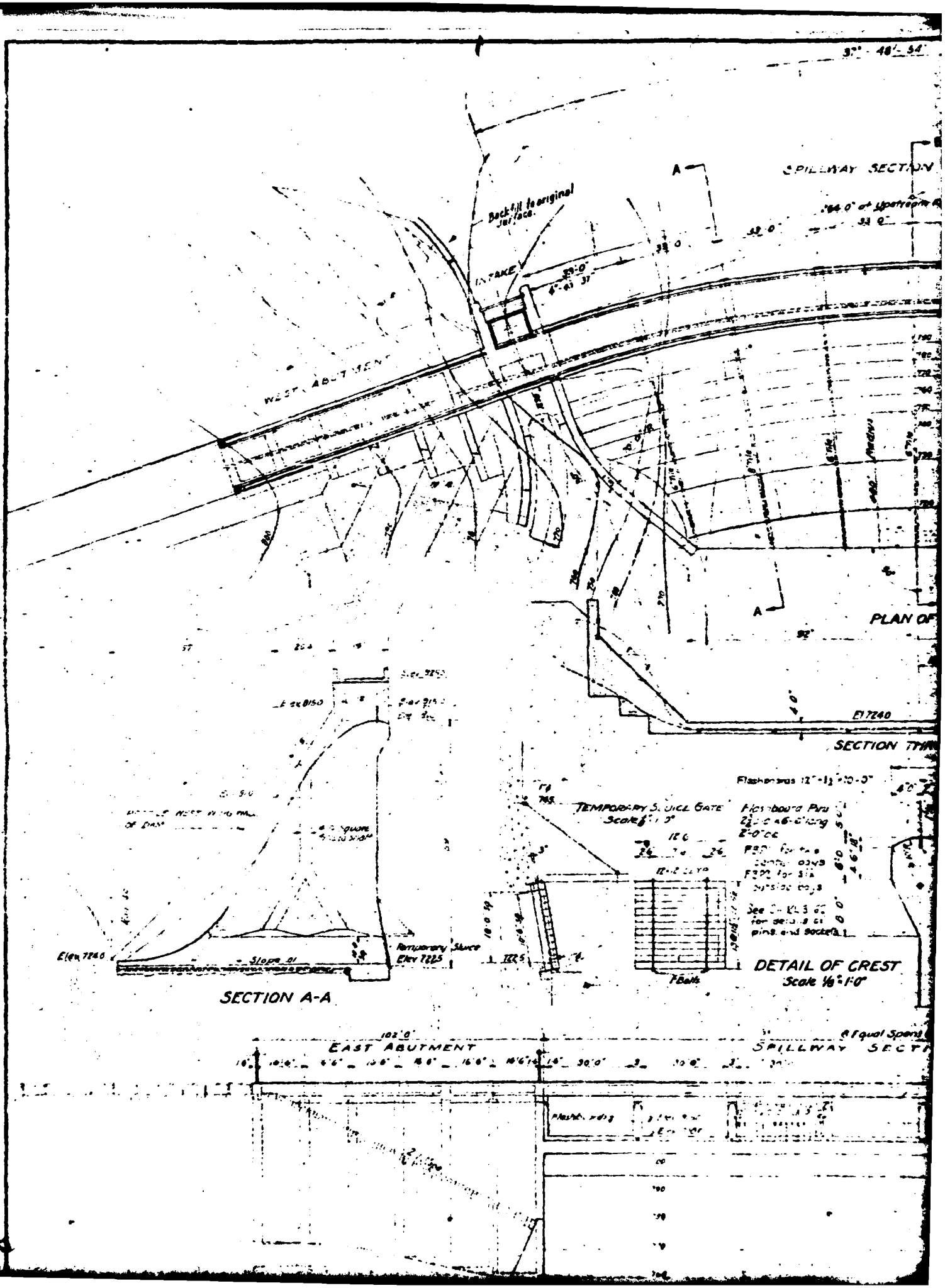
NEW RODS ADDED IN 1979 - SEE SECTIONS AND PLAN

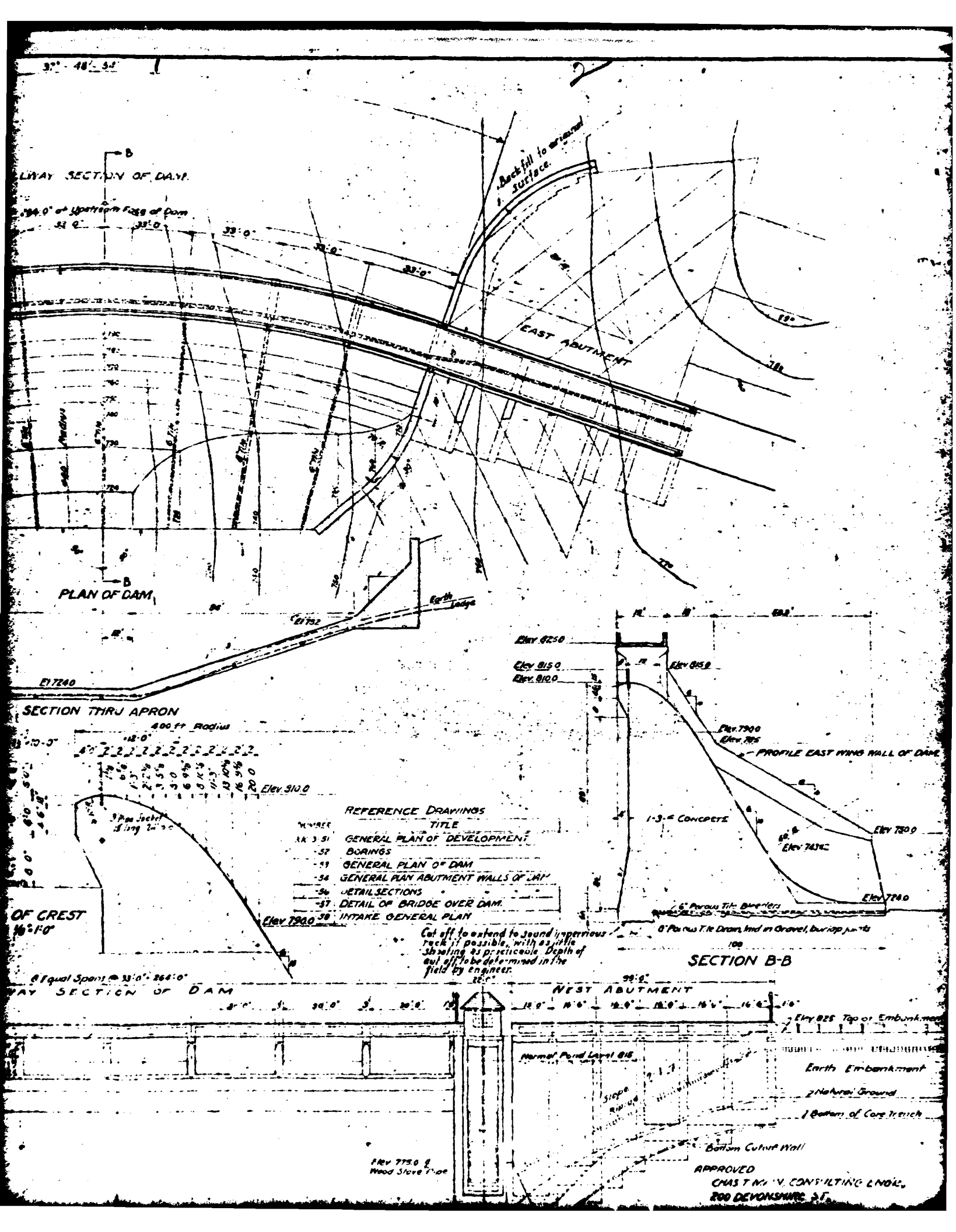
APPROVED
CHAS T MAIN, CONSULTING ENGINEER
200 DEVONSHIRE STREET
BOSTON, MASS.
BY Chas T. Main

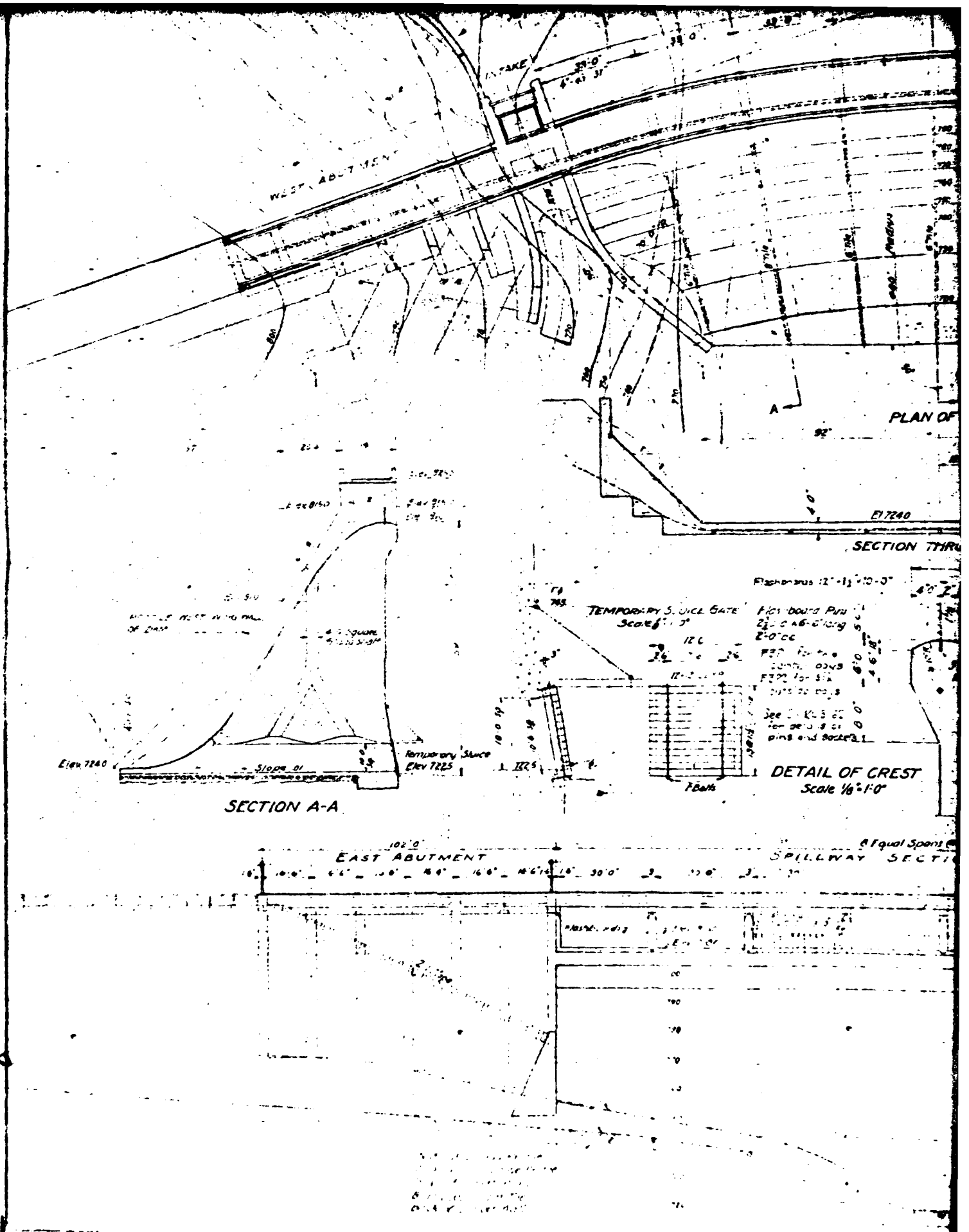
FILE C-9

CATSKILL POWER CORP MIDDLETOWN, NY

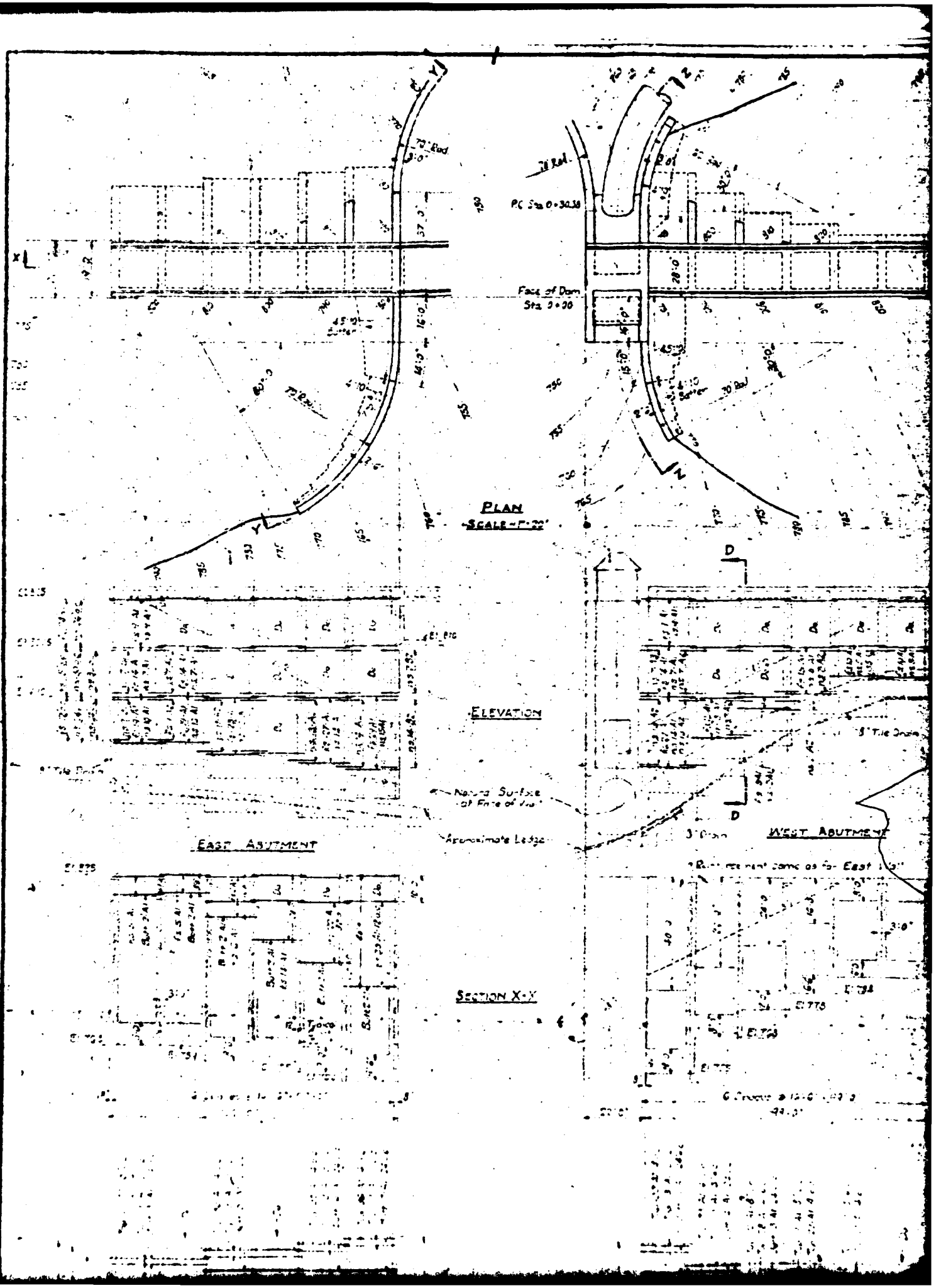
REVISIONS	RIO DEVELOPMENT DETAILS OF BRIDGE OVER DAM	DWG. D 2 3
	CHARLES H. TENNEY & CO. ENGINEERS BOSTON, MASS.	SEP 1962
	1"=1'0"	KK 3 57

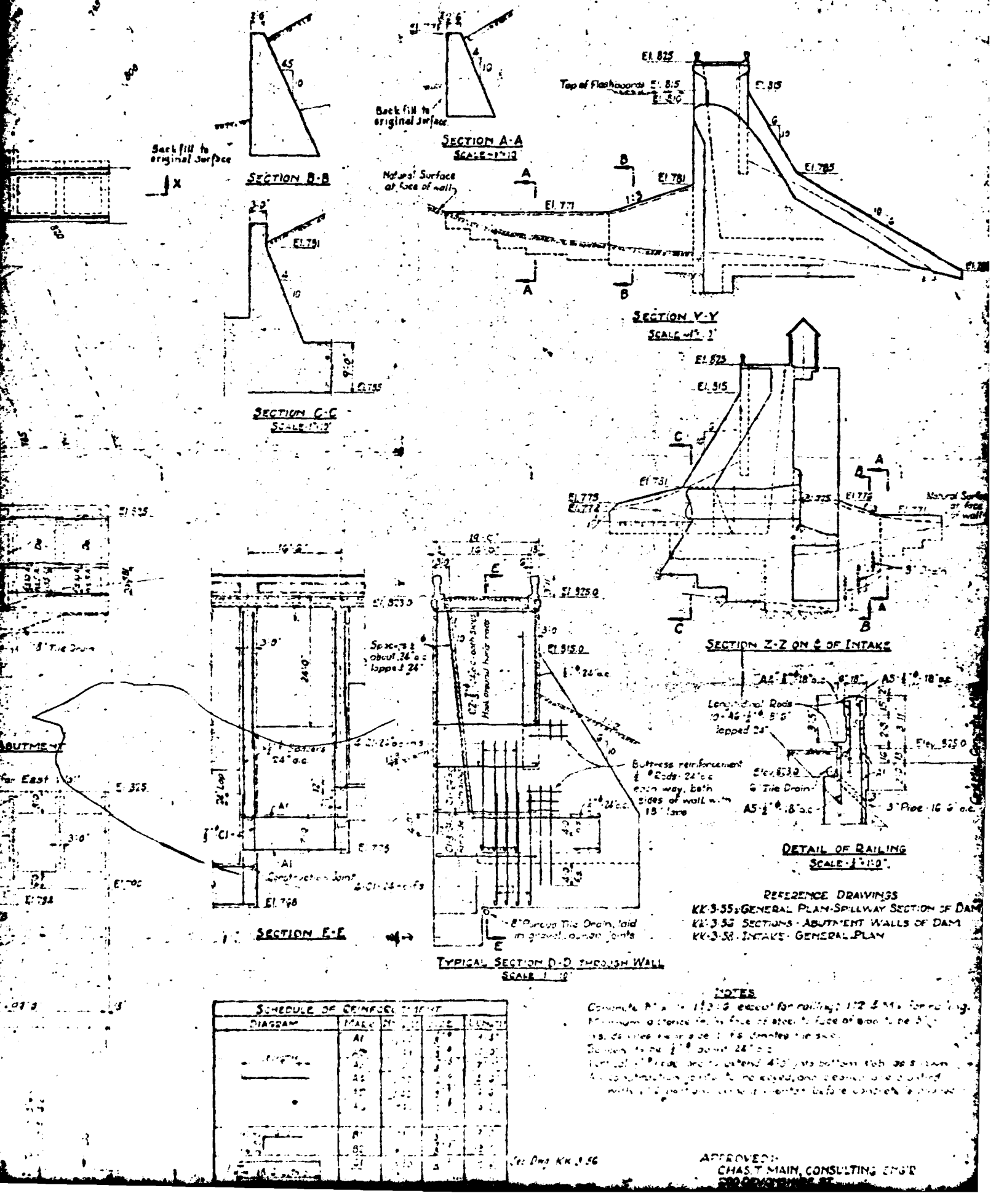

SPILLWAY SECTION
Backfill to original surface.
INTAKE
WEST ABUTMENT
PLAN OF
El 7240
SECTION THRU
TEMPORARY SLUICE GATE
Scale 1" = 1'-0"
DETAIL OF CREST
Scale 1/8" = 1'-0"
SECTION A-A
Elev 7240
Slope 01
Temporary Sluice
Elev 7225
EAST ABUTMENT
SPILLWAY SECTION

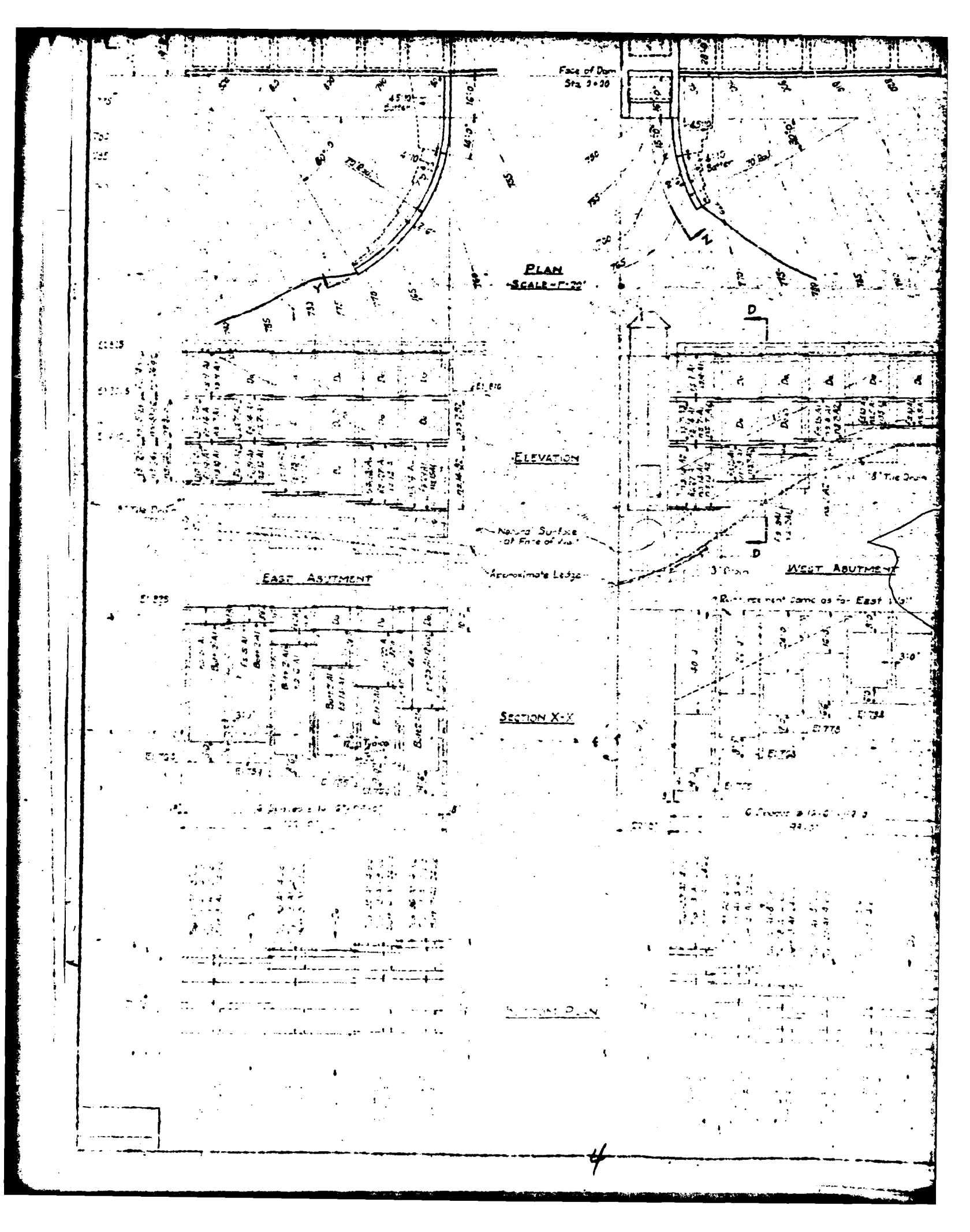

B
LIWAY SECTION OF DAM.
794.0' at Upstream Face of Dam
Backfill to original surface.
EAST ABUTMENT
B
PLAN OF DAM.
Earth Lodge
El 792
El 724.0
SECTION THRU APRON
400 ft Radius
Elev 810.0
OF CREST
1/8" = 1'-0"
Elev 790.0
Elev 825.0
Elev 815.0
Elev 810.0
Elev 790.0
Elev 785
PROFILE EAST WING WALL OF DAM
1-3-6 CONCRETE
Elev 730.0
Elev 724.0
6" Porous Tile Drain, laid on Gravel, burlap joints
SECTION B-B
REFERENCE DRAWINGS
NUMBER
TITLE
GENERAL PLAN OF DEVELOPMENT
BORINGS
GENERAL PLAN OF DAM
GENERAL PLAN ABUTMENT WALLS OF DAM
DETAIL SECTIONS
DETAIL OF BRIDGE OVER DAM.
INTAKE GENERAL PLAN
Cut off to extend to sound impervious rock if possible, with as little shoveling as practicable. Depth of cut off to be determined in the field by engineer.
8 Equal Spans @ 33'-0" = 264'-0"
WAY SECTION OF DAM
WEST ABUTMENT
Elev 825 Top of Embankment
Normal Pond Level 815
Earth Embankment
Natural Ground
Bottom of Core Trench
Bottom Cutoff Wall
Elev 779.0 @ Wood Stave Pipe
APPROVED
CHAS T MAIN, INC. CONSULTING ENGR.
200 DEVONSHIRE ST.

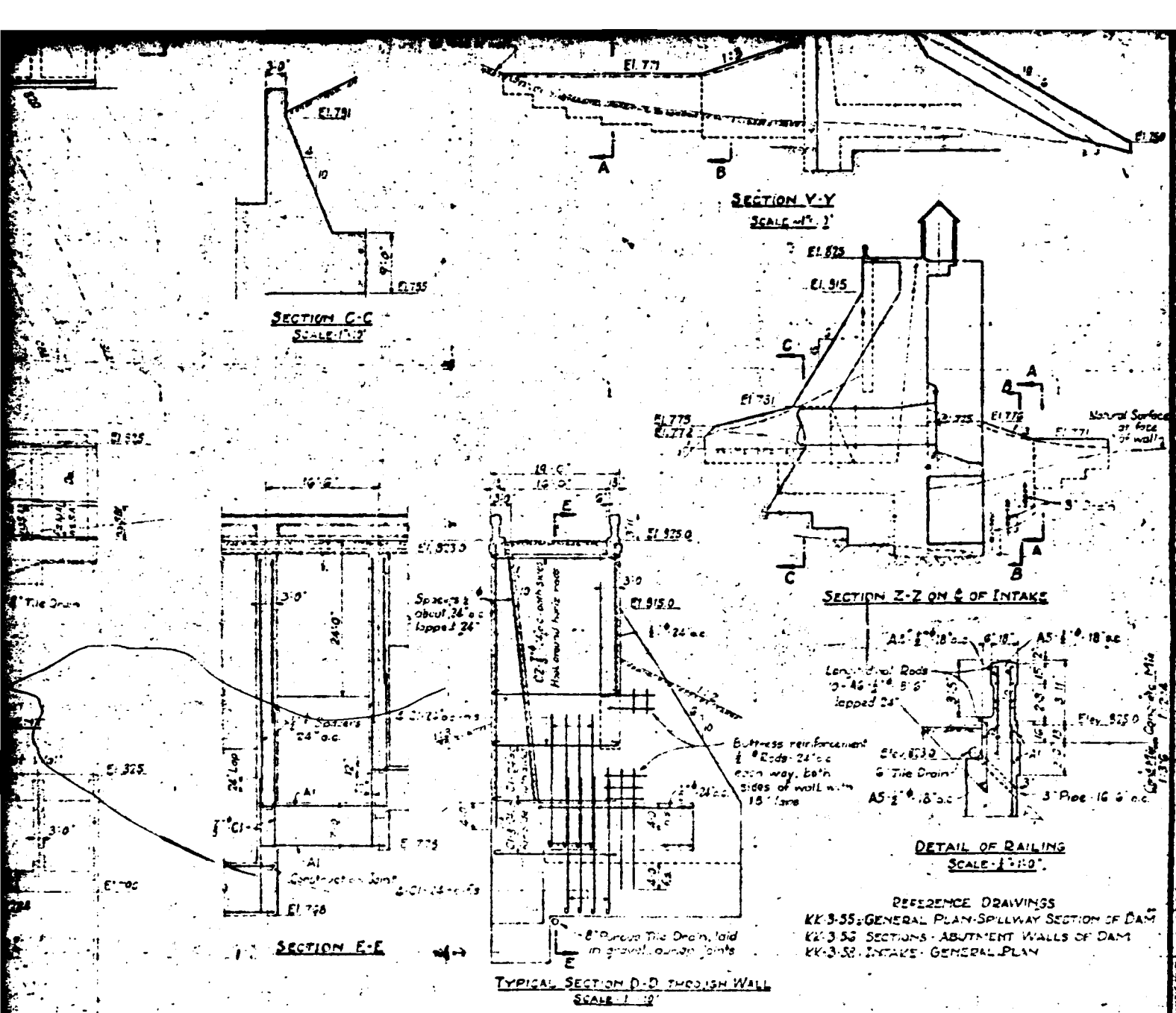

INTAKE
WEST ABUTMENT
PLAN OF
SECTION THRU
El 7240
TEMPORARY SLUICE GATE
Scale 1" = 1'
DETAIL OF CREST
Scale 1/8" = 1'-0"
SECTION A-A
Slope of
Temporary Sluice
Elev 7225
Elev 7240
EAST ABUTMENT
SPILLWAY SECTI
PROFILE

EAST ABUTMENT
PLAN OF DAM
Earth Ledge
El 7240
SECTION THRU APRON
400 ft Radius
Elev 810.0
OF CREST
Elev 790.0
Elev 825.0
Elev 815.0
Elev 810.0
Elev 790.0
Elev 785
PROFILE EAST WING WALL OF DAM
1-3-4 CONCRETE
Elev 780.0
Elev 743.0
Elev 724.0
6" Porous Tile Diverters
6" Porous Tile Drain, laid in Gravel, burlap joints
SECTION B-B
8 Equal Spans @ 33'-0" = 264'-0"
WAY SECTION OF DAM
WEST ABUTMENT
Elev 825 Top of Embankment
Normal Pond Level 815
Earth Embankment
Natural Ground
Bottom of Core Trench
Bottom Cutoff Wall
Elev 775.0 ℄ Wood Stave Pipe
6" Porous Tile Drain back of Cutoff Wall
PROJECTED INTAKE FACE OF DAM
REFERENCE DRAWINGS
NUMBER TITLE
XX-3-51 GENERAL PLAN OF DEVELOPMENT
-52 BORINGS
-53 GENERAL PLAN OF DAM
-54 GENERAL PLAN ABUTMENT WALLS OF DAM
-56 DETAIL SECTIONS
-57 DETAIL OF BRIDGE OVER DAM
-58 INTAKE GENERAL PLAN
Cut off to extend to sound impervious rock if possible, with as little shooting as practicable. Depth of cut off to be determined in the field by engineer.
APPROVED
CHAS T MAIN CONSULTING ENGR
200 DEVONSHIRE ST.
BOSTON, MASS
BY
FILE C-8
CATSKILL POWER CORP MIDDLETOWN N.Y.
RIO DEVELOPMENT
GENERAL PLAN
SPILLWAY SECTION OF DAM


PLAN
SCALE - 1" = 20'
ELEVATION
SECTION X-X
EAST ABUTMENT
WEST ABUTMENT
Face of Dam
Sta 0+00
PC Sta 0+30.38
Natural Surface at Face of Dam
Approximate Ledge
3' Tile Drain
D
X
Y


Back fill to original surface
SECTION B-B
Back fill to original surface
SECTION A-A
SCALE 1"=10'
El. 825
Top of Flashboards El. 815
El. 810
El. 815
El. 785
Natural Surface at face of wall
El. 781
El. 771
1:2
SECTION Y-Y
SCALE 1" = 10'
El. 791
SECTION C-C
SCALE 1"=10'
El. 825
El. 815
El. 791
El. 775
El. 771
SECTION Z-Z ON ℄ OF INTAKE
El. 825.0
El. 815.0
El. 798
Construction Joint
SECTION E-E
Buttress reinforcement
Tile Drain laid in gravel around joints
TYPICAL SECTION D-D THROUGH WALL
SCALE 1" = 10'
DETAIL OF RAILING
SCALE 1" = 1'-0"
REFERENCE DRAWINGS
KK-3-55 GENERAL PLAN-SPILLWAY SECTION OF DAM
KK-3-56 SECTIONS - ABUTMENT WALLS OF DAM
KK-3-58 INTAKE - GENERAL PLAN
SCHEDULE OF REINFORCEMENT
DIAGRAM
MARK
NOTES
APPROVED:
CHAS. T. MAIN, CONSULTING ENGR.


Face of Dam
Sta 3+30
PLAN
SCALE - 1" = 20'
ELEVATION
Natural Surface of Face of Dam
Approximate Ledge
EAST ABUTMENT
WEST ABUTMENT
SECTION X-X
D
D
3" Tile Drain



SECTION C-C
SCALE 1"=2'

SECTION V-V
SCALE 1"=2'

SECTION Z-Z ON ℄ OF INTAKE

SECTION E-E

DETAIL OF RAILING
SCALE 1"=1'-0"

TYPICAL SECTION D-D THROUGH WALL
SCALE 1"=2'

REFERENCE DRAWINGS
KK-3-55: GENERAL PLAN-SPILLWAY SECTION OF DAM
KK-3-56 SECTIONS - ABUTMENT WALLS OF DAM
KK-3-52 INTAKE - GENERAL PLAN

NOTES

SCHEDULE OF REINFORCEMENT

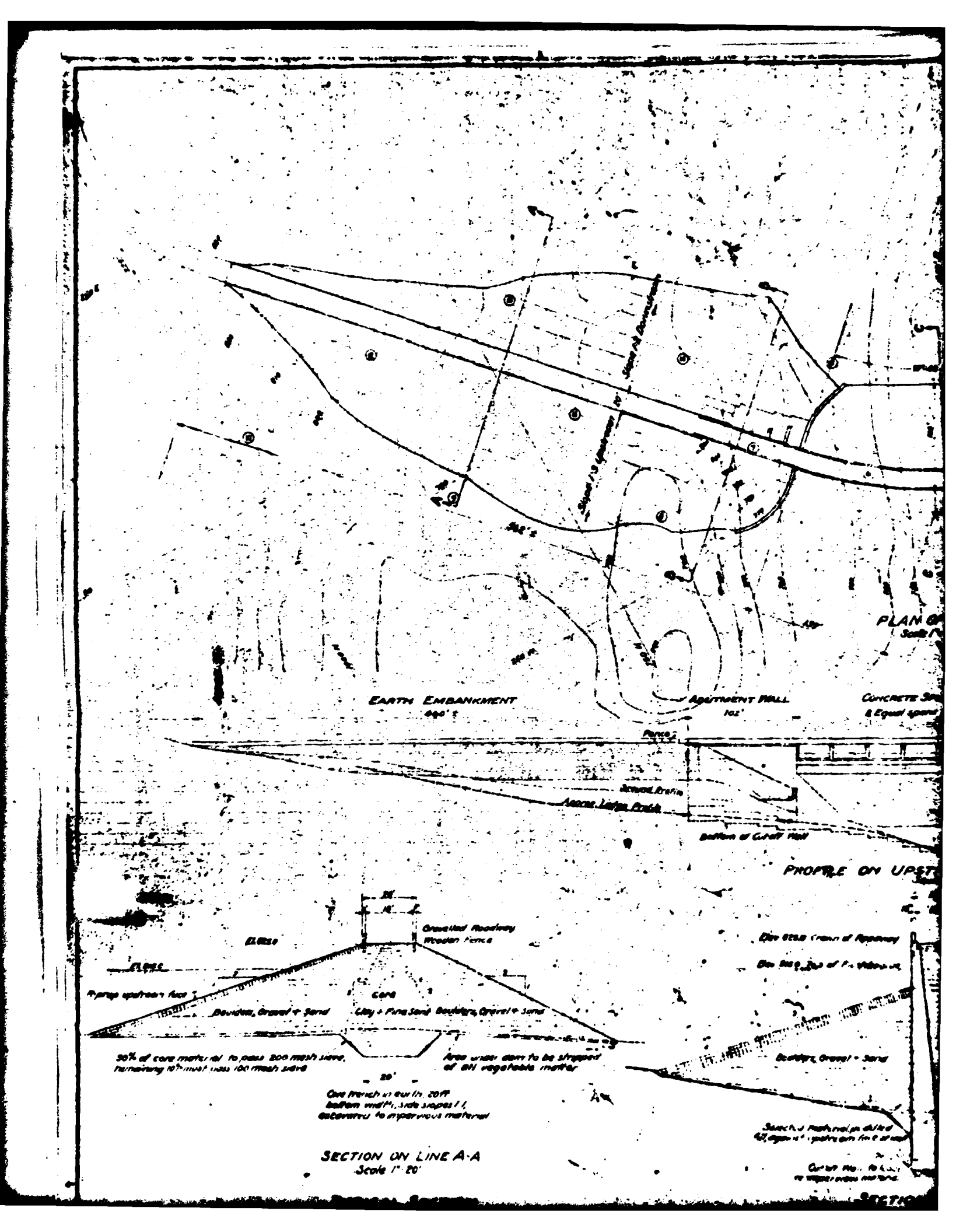
DIAGRAM	MARK	NO.	SIZE	LENGTH
	A1			
	A2			
	A3			
	A4			
	A5			
	B1			
	B2			
	C1			
	C2			
	C3			

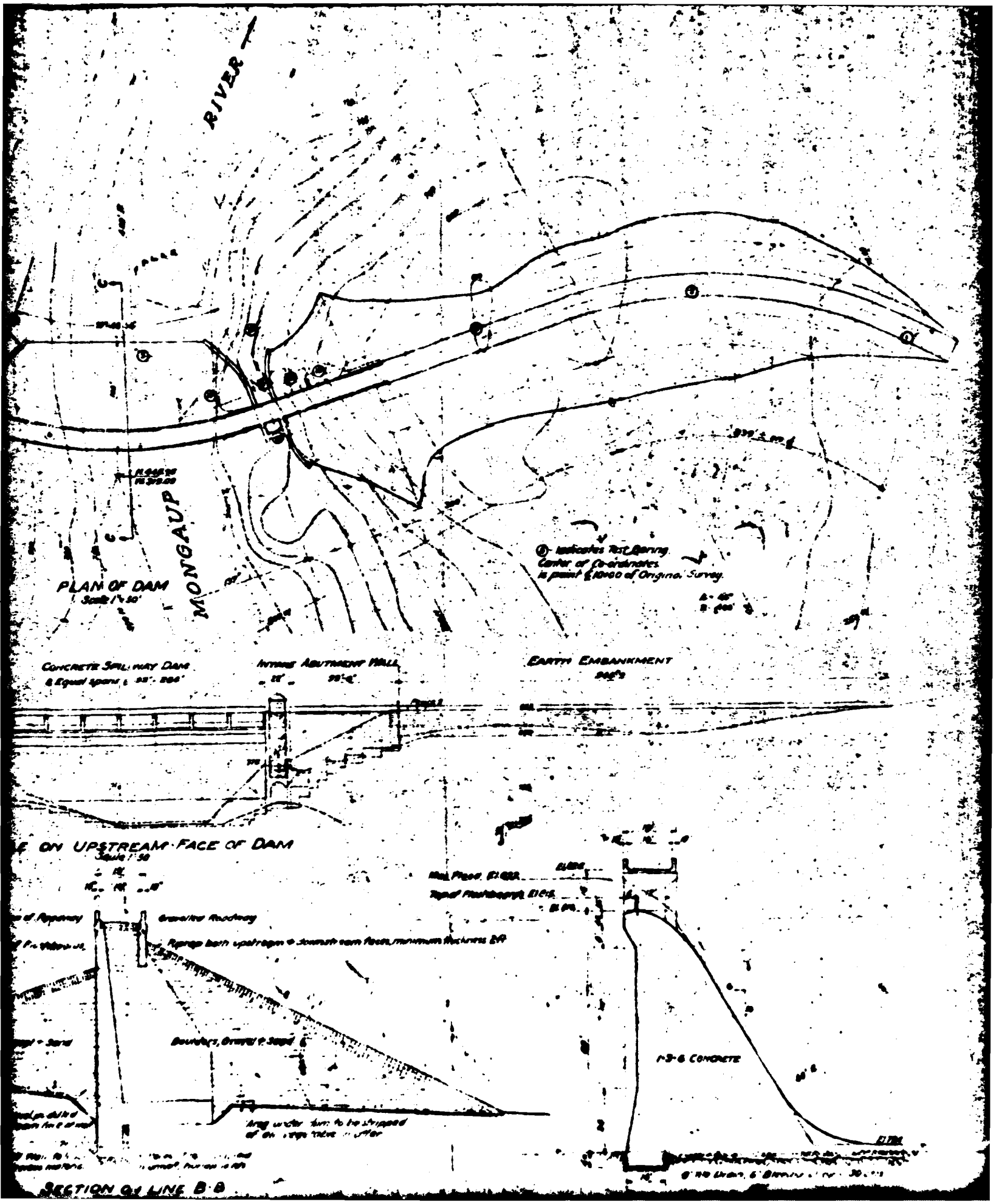
See Dwg KK-3-56
See Dwg KK-3-56
See Dwg KK-3-56

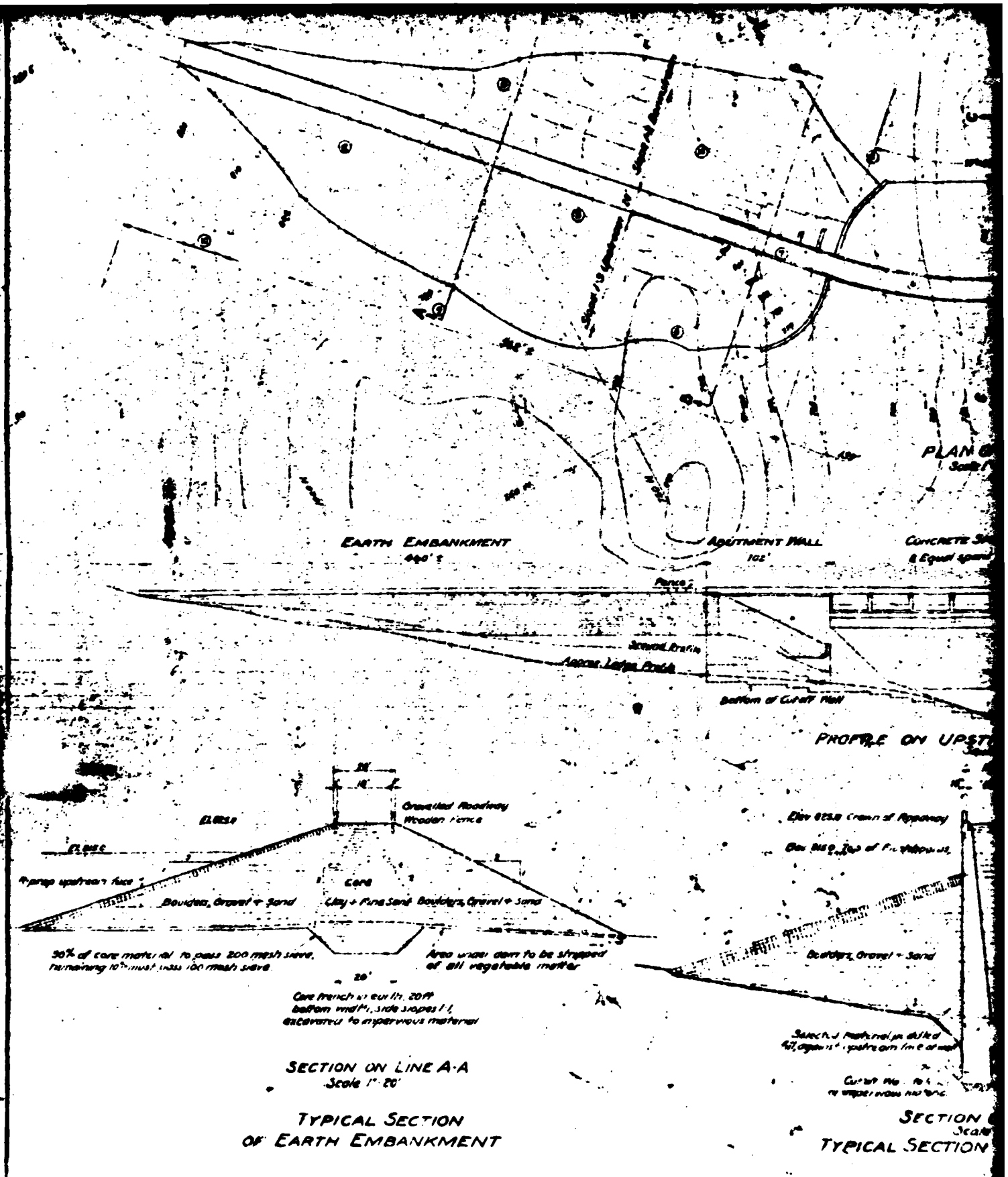
APPROVED:
CHAS. T. MAIN, CONSULTING ENGR.
BOSTON, MASS.
BY

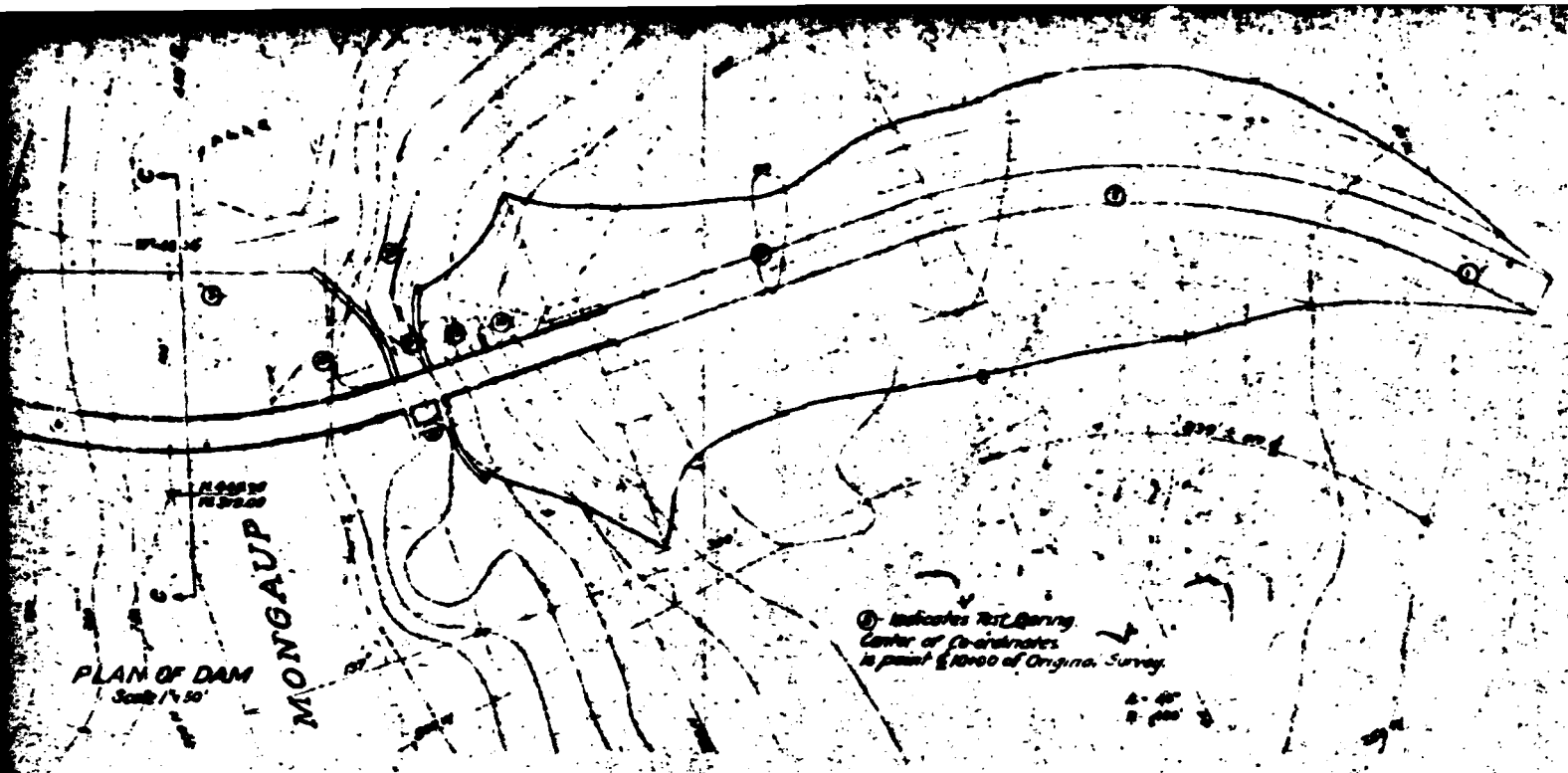
FILE C-7

CATSKILL AQUEDUCT — KINGSTON

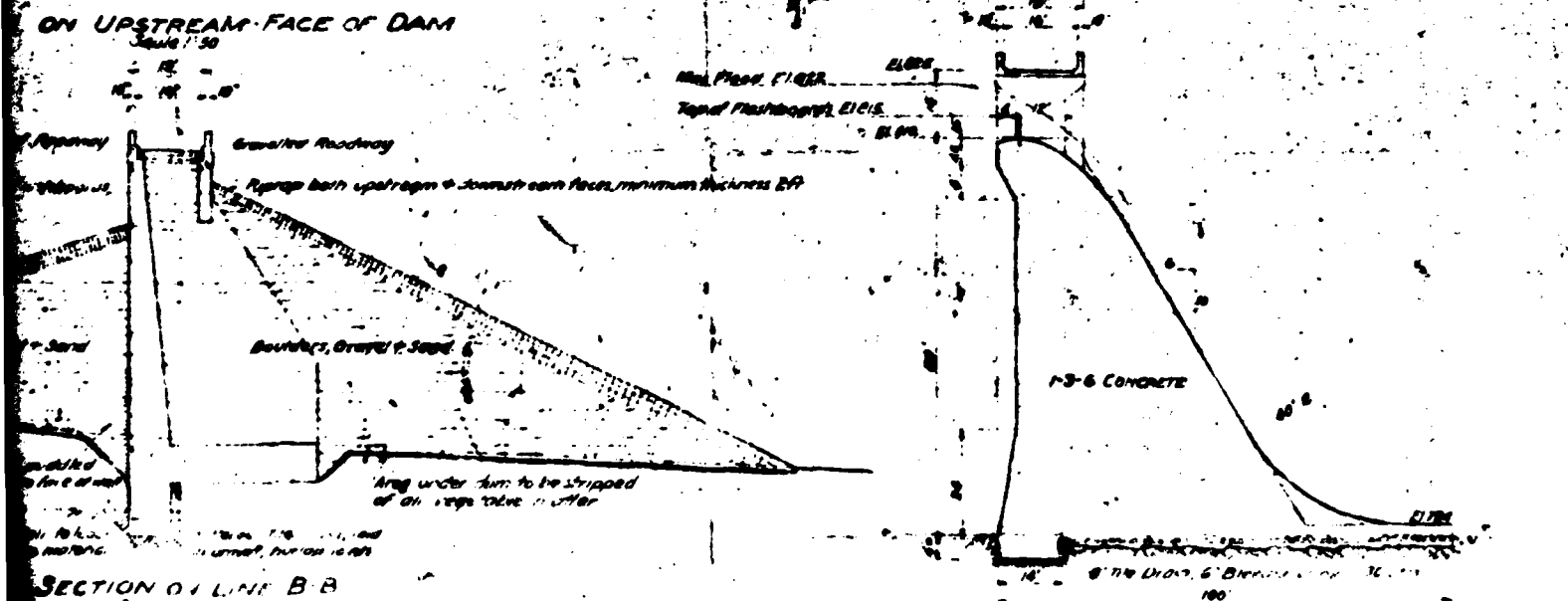

EARTH EMBANKMENT
ABUTMENT WALL
Fence
Ground Profile
Bottom of Cutoff Wall
Crowned Roadway
Wooden Fence
Core
Boulder, Gravel & Sand
Clay & Fine Sand
Boulder, Gravel & Sand
Area under dam to be stripped of all vegetable matter
Boulder, Gravel & Sand
SECTION ON LINE A-A
Scale 1" = 20'


RIVER
MONGAUP
PLAN OF DAM
Scale 1"= 50'
Indicates Test Boring
Center of Co-ordinates
is point ℄ 10+00 of Original Survey.
CONCRETE SPILLWAY DAM
INTAKE ABUTMENT WALL
EARTH EMBANKMENT
E ON UPSTREAM FACE OF DAM
Scale 1"=50'
Gravel for Roadway
Boundary, Gravel & Sand
Rip-rap Concrete
SECTION ON LINE B-B


EARTH EMBANKMENT
440'±
ABUTMENT WALL
102'
Fence
Original Profile
Approx. Lining Profile
Bottom of Cut-off Wall
PROFILE ON UPST
Gravelled Roadway
Wooden Fence
El 855.0
El 845.5
Rip-rap upstream face
Boulders, Gravel + Sand
Core
Clay + Fine Sand
Boulders, Gravel + Sand
30% of core material to pass 200 mesh sieve,
remaining 10% must pass 100 mesh sieve
Area under dam to be stripped
of all vegetable matter
Core trench as built, 20ft
bottom width, side slopes 1:1,
excavated to impervious material
Boulders, Gravel + Sand
Elev 855.0 Crown of Roadway
Elev 845.0 Top of Fuse Plug
Selected material as called
for, approved spoil from line of work
Cut-off Wall not
to impervious material
SECTION ON LINE A-A
Scale 1" = 20'
TYPICAL SECTION
OF EARTH EMBANKMENT
SECTION
Scale
TYPICAL SECTION



ON UPSTREAM FACE OF DAM

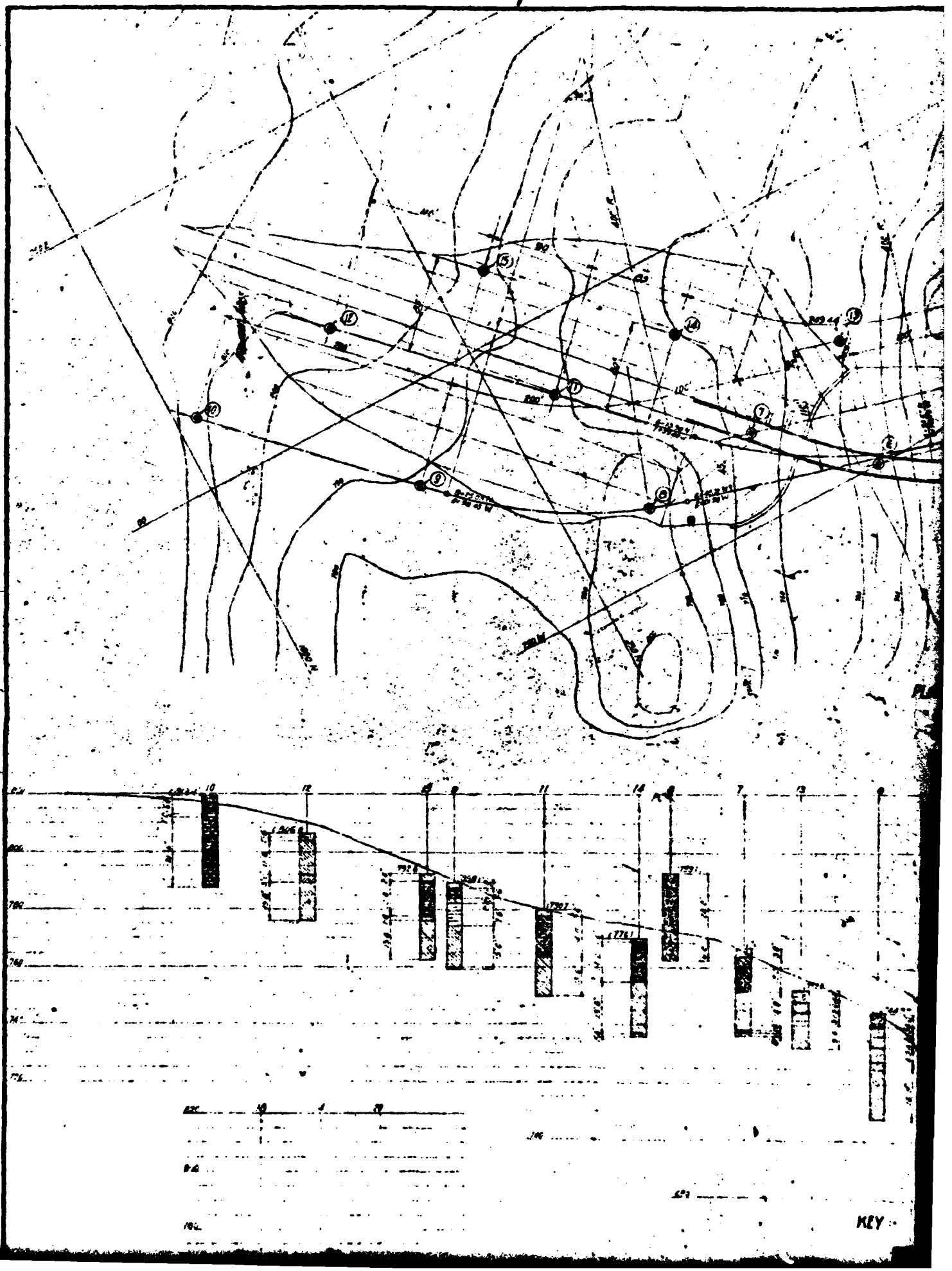


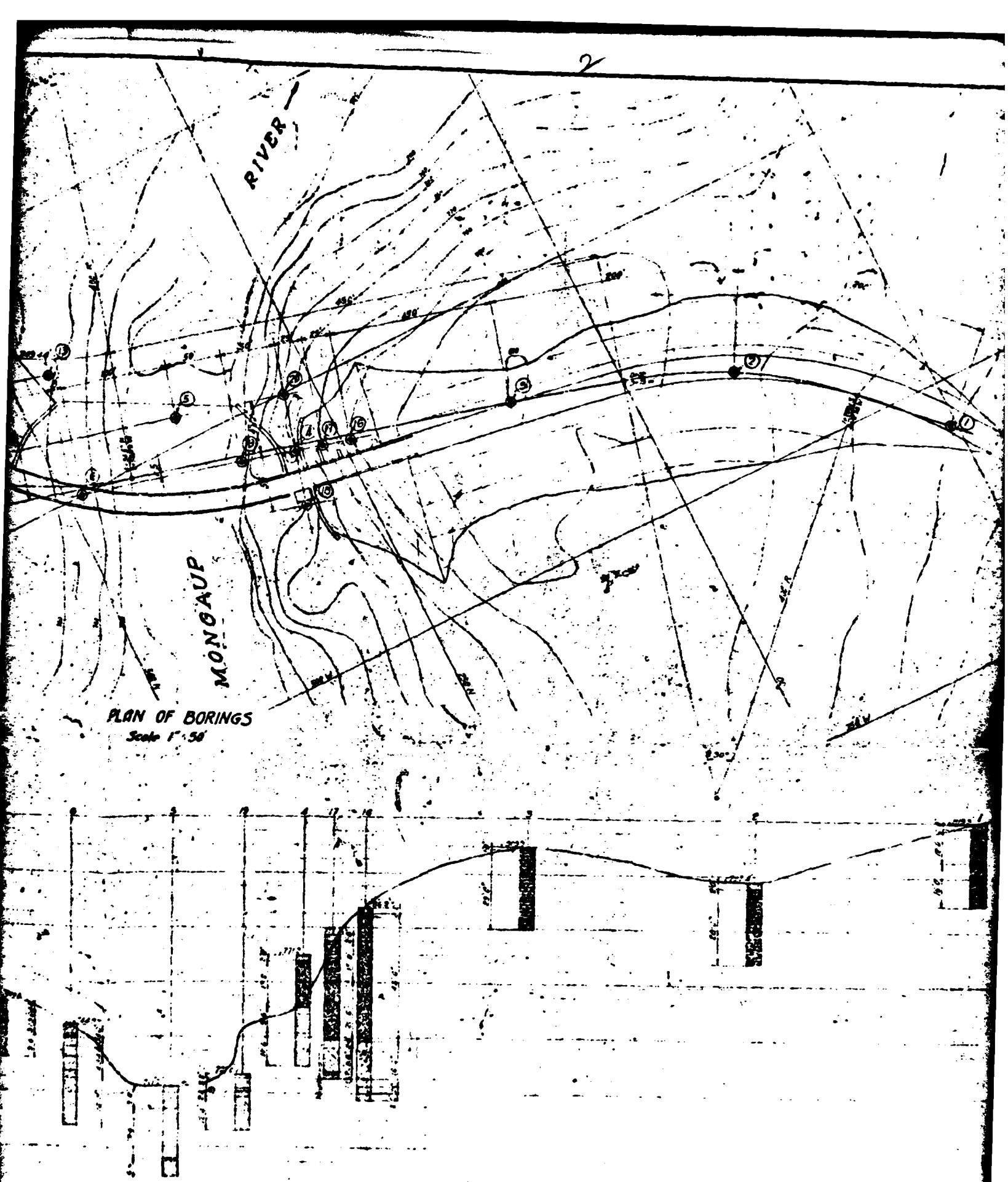
SECTION ON LINE B-B
Scale 1"=20'
SECTION ABUTMENT WALL

SECTION ON LINE C-C CONCRETE SPILLWAY
Scale 1"=20'

APPROVED:
CHAS T MAIN, CONSULTING ENGR.
100 DEVONSHIRE ST.
BOSTON, MASS.

CATSKILL POWER CORP
RIO DEVELOPMENT
DAM


KEY



PLAN OF BORINGS
Scale 1" = 50'

KEY:-

Loam and topsoil.

Sand and gravel.

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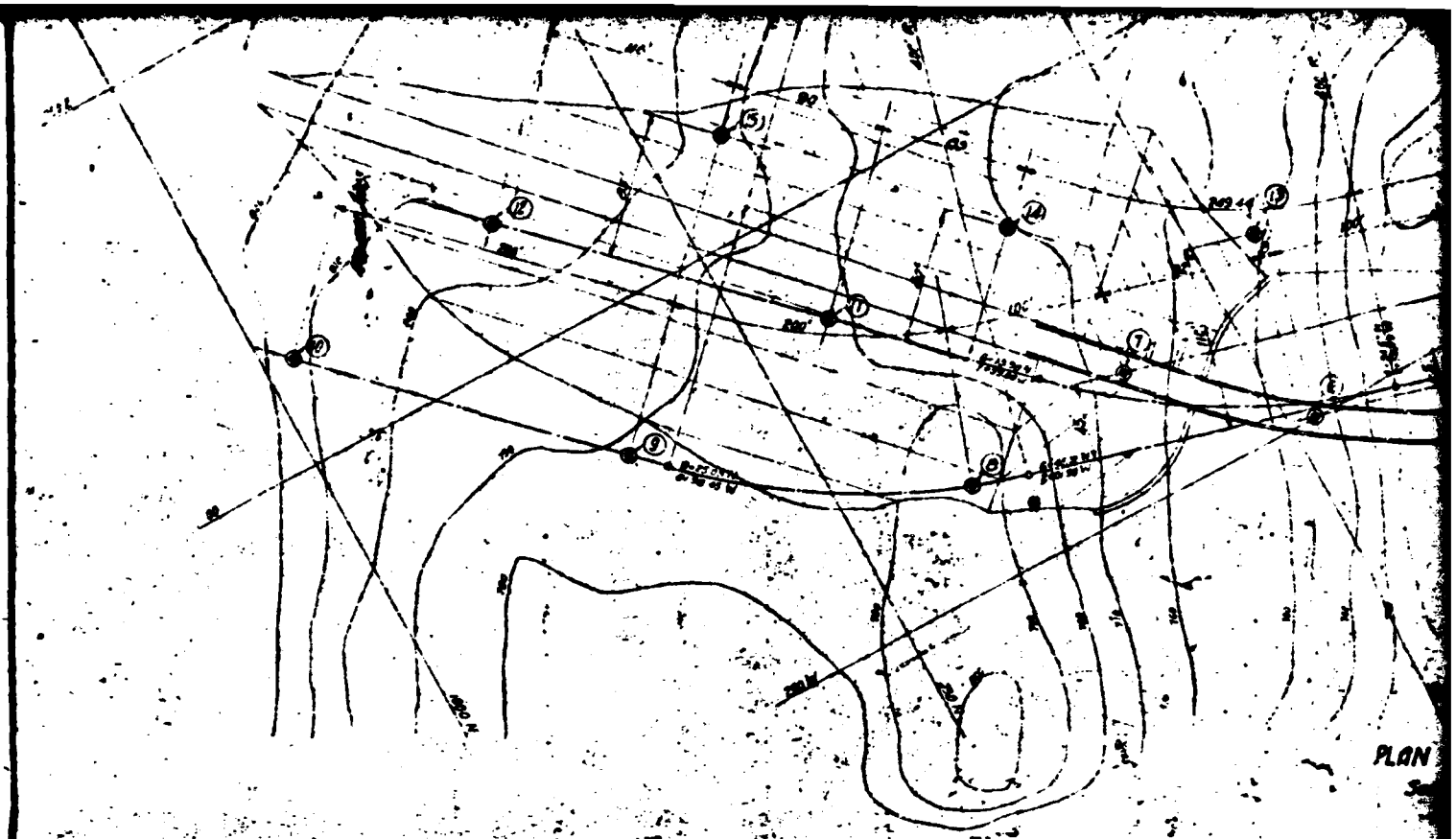
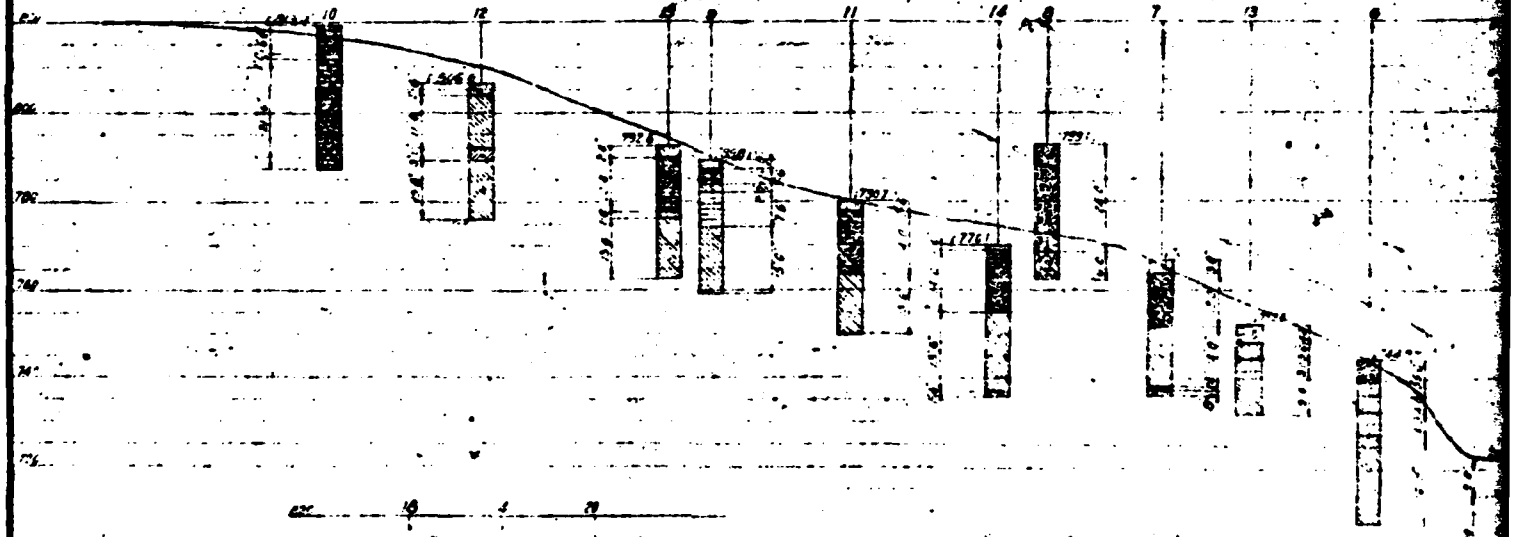
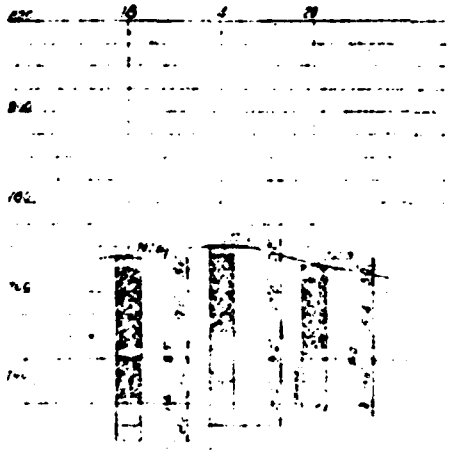
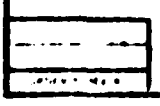
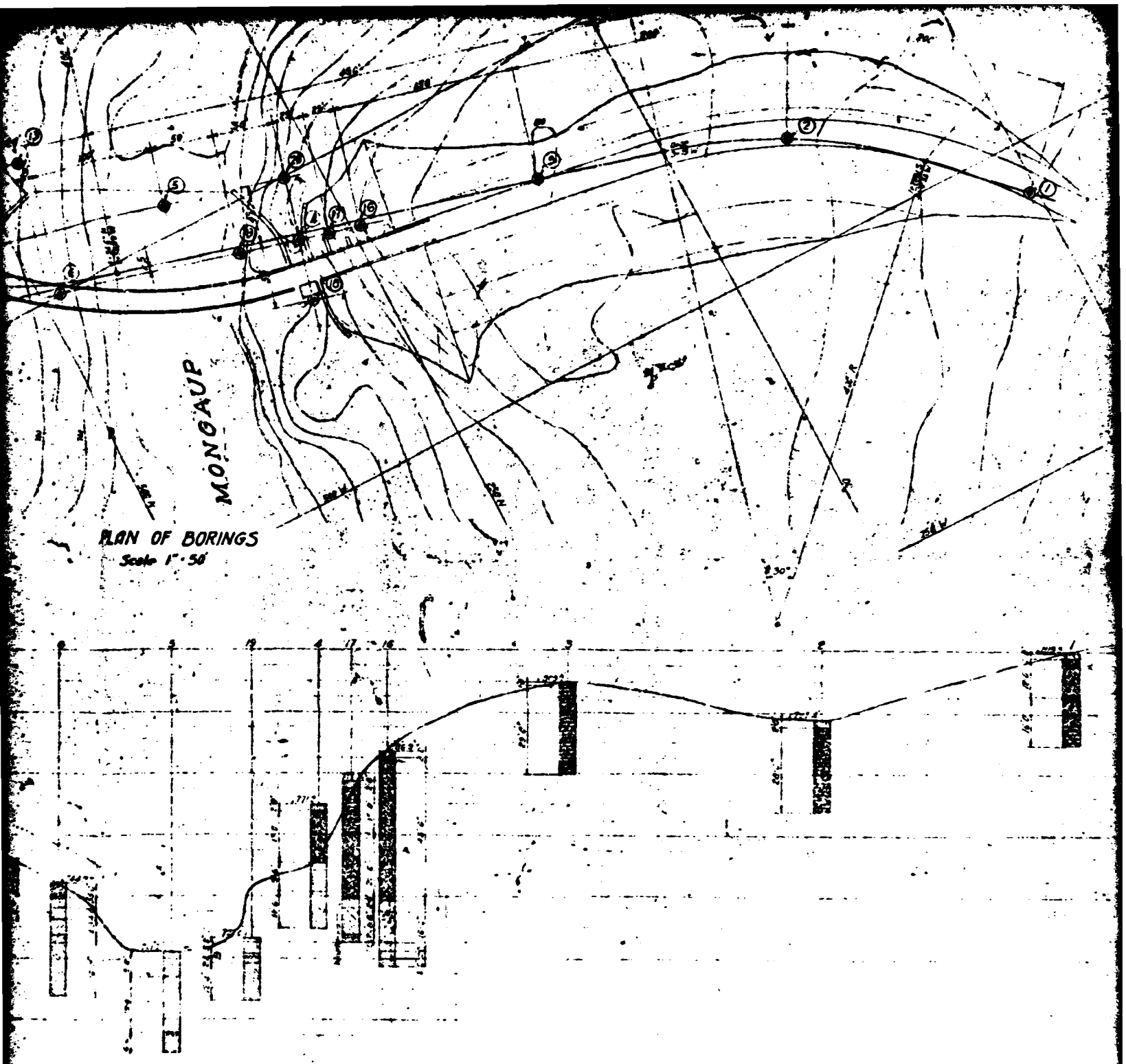
CHAS T MAIN. CONSULTING ENGR
200 DEVONSHIRE ST
BOSTON, MASS.


PLAN









PLAN OF BORINGS
Scale 1" = 50'

KEY :-

- Loam and topsoil
- Sandstone
- Sand
- Clay and sand
- Clay, sand and gravel
- Sand and gravel
- Shale
- Boulders
- Sand, gravel and boulders
- Clay

APPROVED
CHAS T MAIN, CONSULTING ENGR
200 DEVONSHIRE ST
BOSTON, MASS
BY Chas T. Main

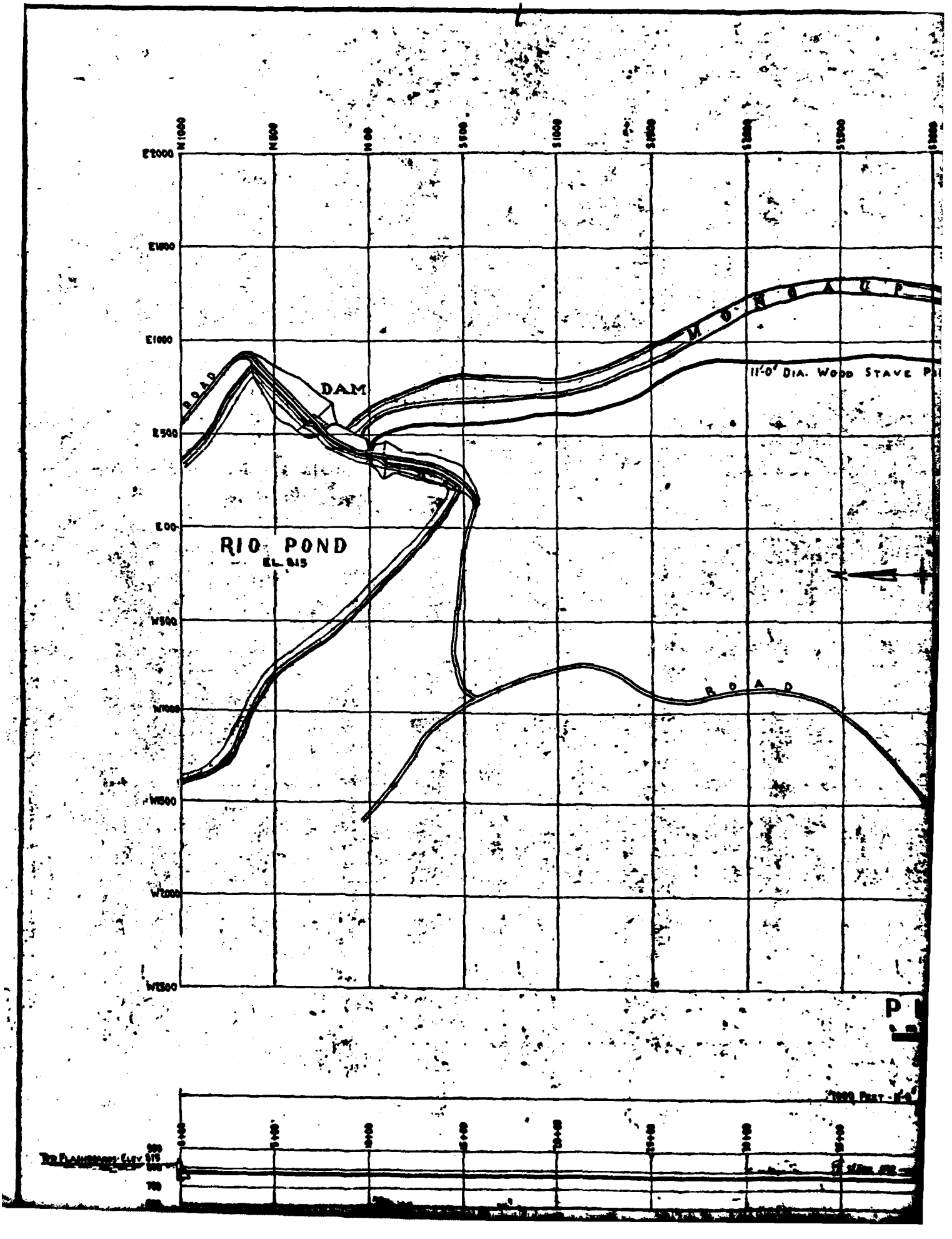
CATSKILL POWER CORP MIDDLETOWN, N.Y.

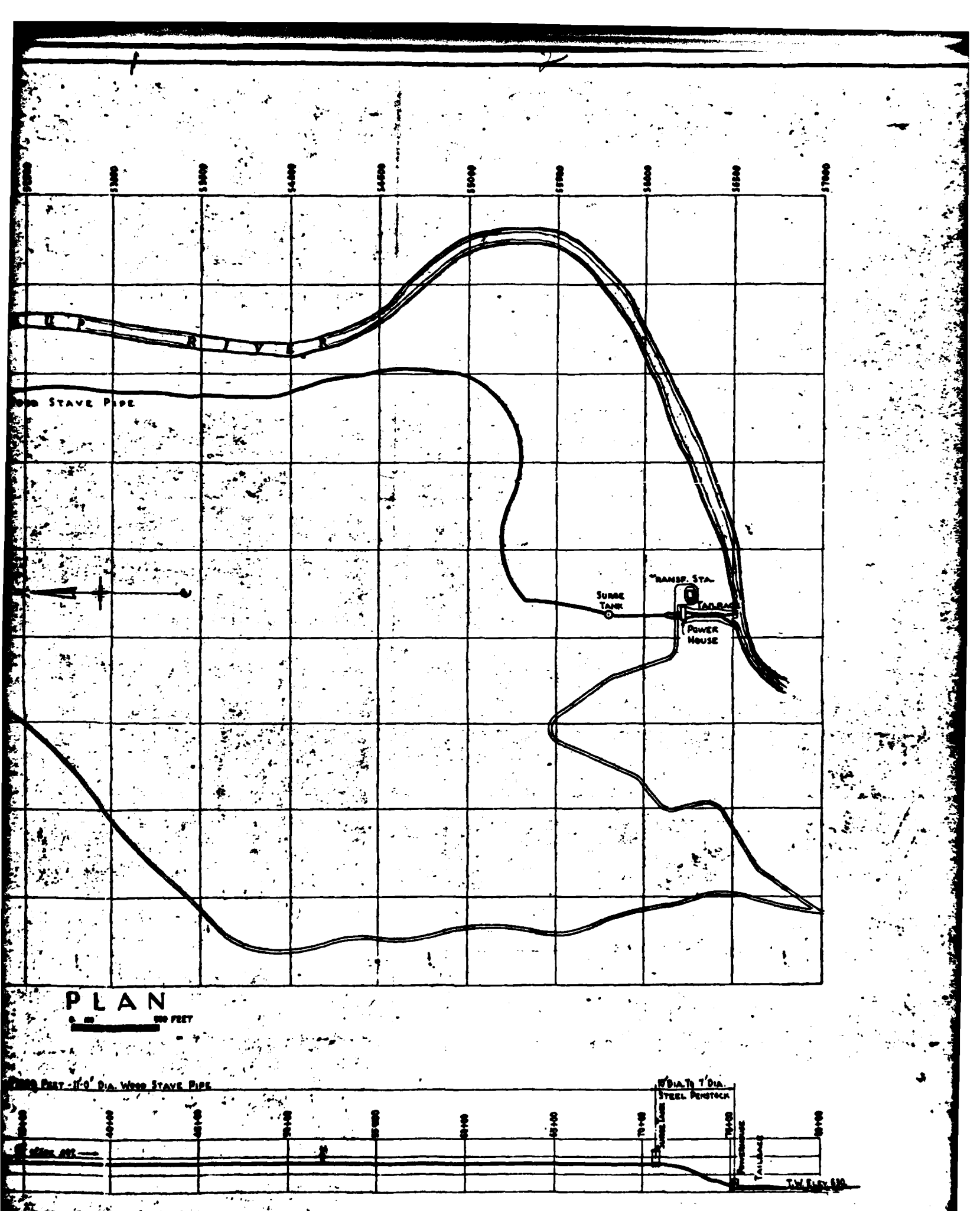
REVISIONS

RIO DEVELOPMENT
BORINGS

Prepared by CHARLES H TENNEY & CO
ENGINEERS BOSTON, MASS

KH 3 52


N1000
N500
N00
S500
S1000
S1500
S2000
S2500
E2000
E1500
E1000
E500
E00
W500
W1000
W1500
W2000
W2500
ROAD
DAM
RIO POND
EL. 815
ROAD
11'-0" DIA. WOOD STAVE



PLAN

0 200 FEET

Feet - 11'-0" Dia. Wood Stave Pipe

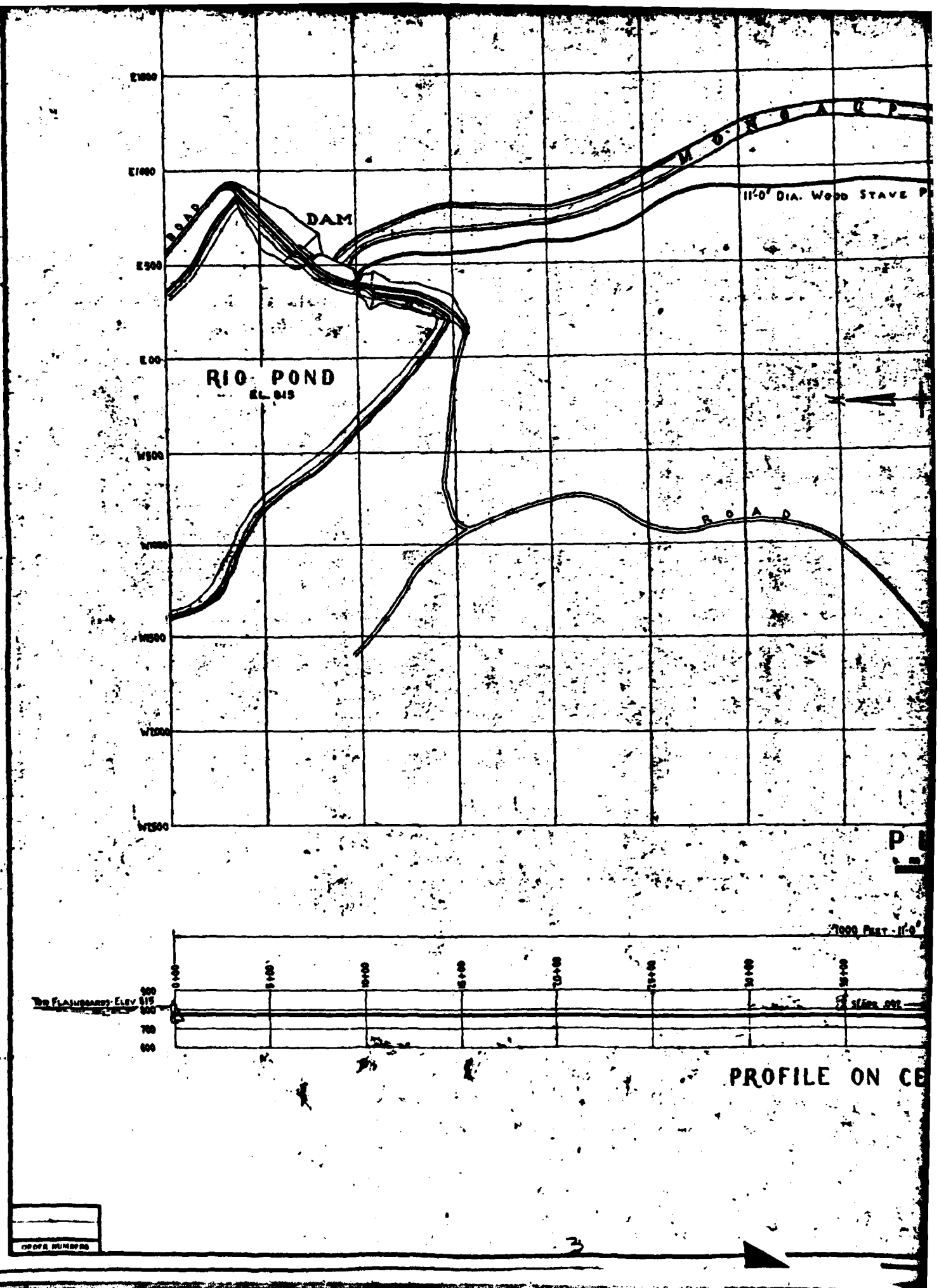
11' Dia. To 7' Dia. Steel Penstock

Surge Tank

Powerhouse

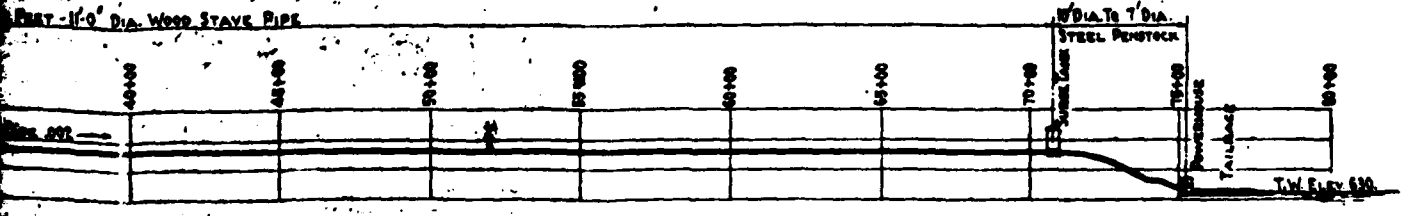
Tailrace

T.W. Elev. 610


E1000
E500
E00
W500
W1000
W1500
DAM
RIO POND
EL. 815
ROAD
ROAD
11'-0" DIA. WOOD STAVE
PROFILE ON CE

PLAN

0 100 500 FEET



ON CENTERLINE OF PIPE

APPROVED:
CHAS. T. MAIN, INC CONSULTING ENGRS
201 DEVONSHIRE ST.
BOSTON MASS.
BY Charles T. Main

ROCKLAND LIGHT & POWER CO. — NYACK N.Y.

REVISIONS

RIO DEVELOPMENT
GENERAL PLAN

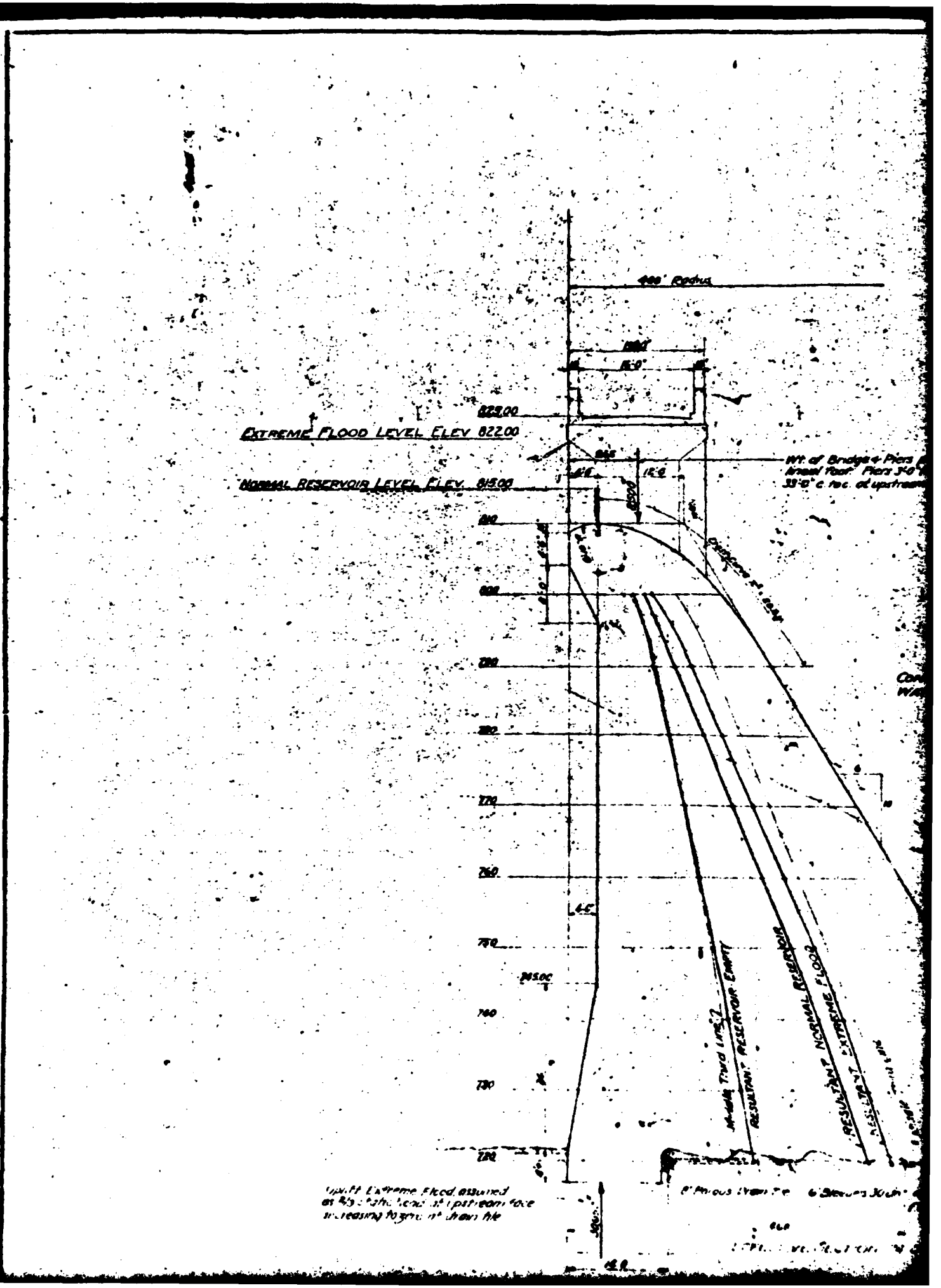
PREPARED BY CHARLES H. TENNEY & CO. ENGINEERS — BOSTON, MASS.

Drawn: E.W.G. | Traced: W | Checked:

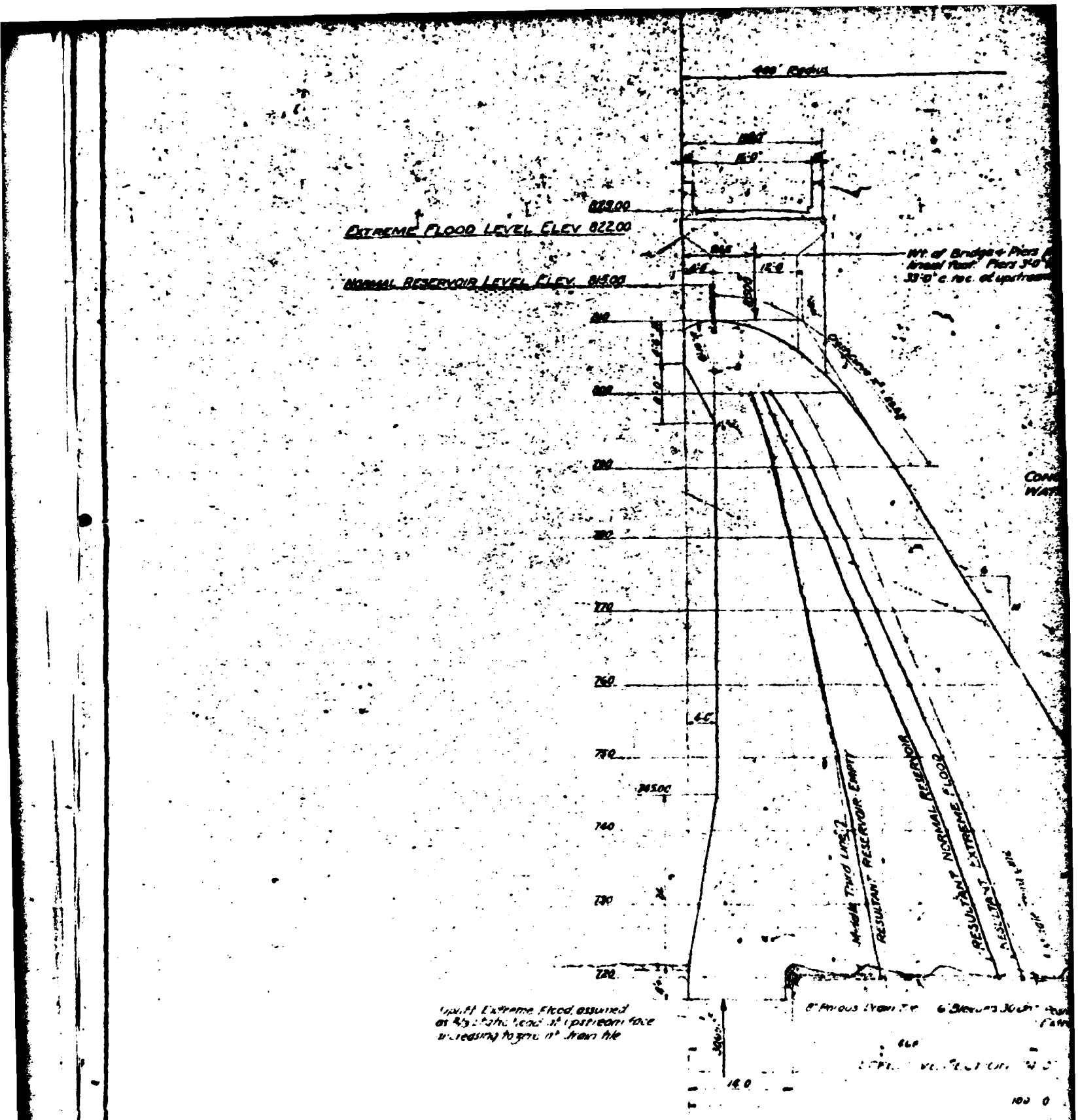
Comments:

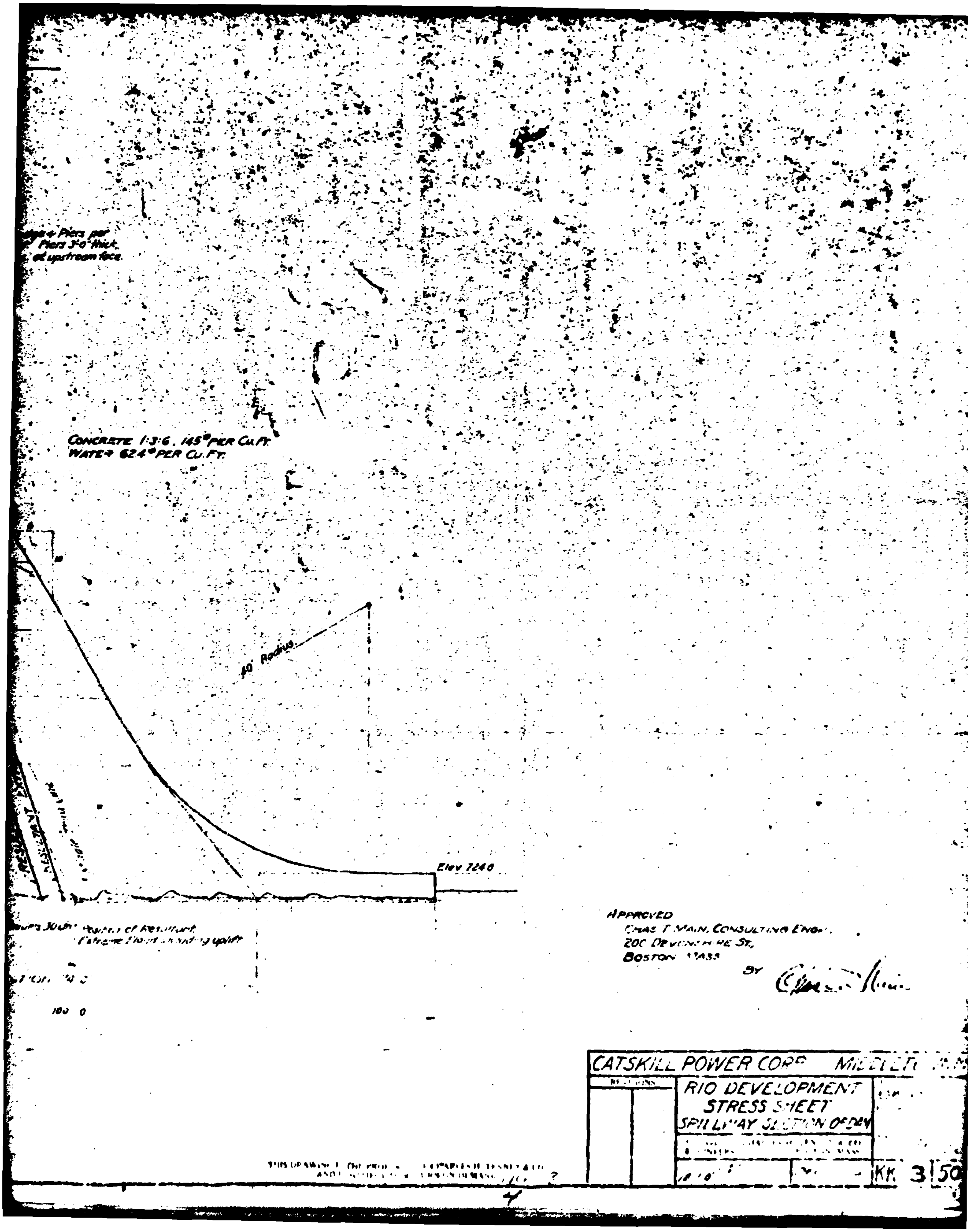
Approved: W. F. Hall

SCALE 1" = 300' | JAN 16, 1929 | KK 3 51-A


400' Radius
EXTREME FLOOD LEVEL ELEV 822.00
NORMAL RESERVOIR LEVEL ELEV. 815.00
RESULTANT NORMAL RESERVOIR FLOOD
RESULTANT EXTREME FLOOD
RESULTANT EMPTY

APPROVED
CHAS T MAIN, CONSULTING ENGR.
200 DEVONSHIRE ST,
BOSTON MASS
BY


EXTREME FLOOD LEVEL ELEV 822.00
NORMAL RESERVOIR LEVEL ELEV. 815.00
400' Radius
822.00
820
800
780
760
740
720
RESULTANT NORMAL RESERVOIR
RESULTANT EXTREME FLOOD
RESULTANT EMPTY
18.0



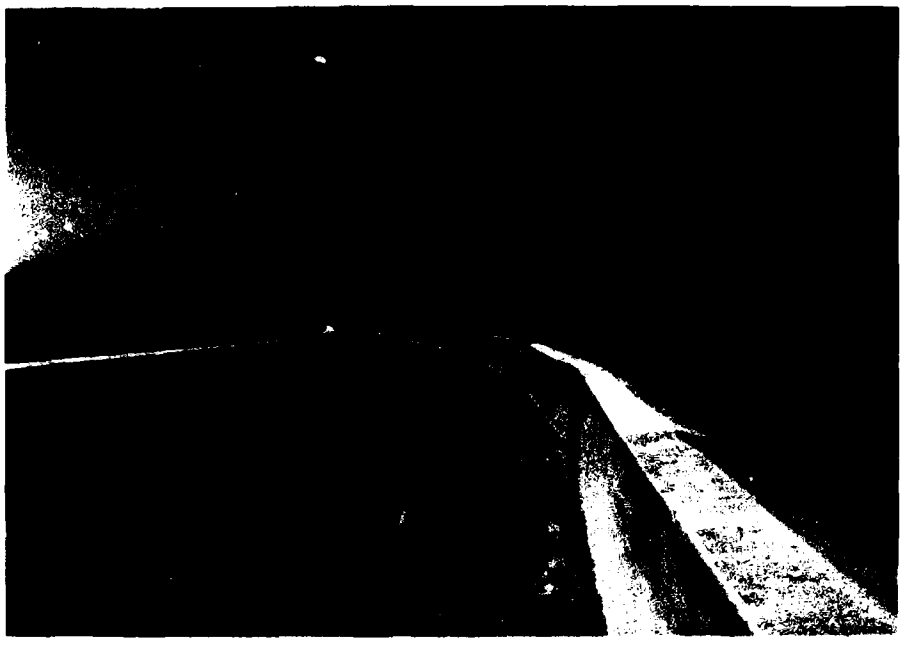
at upstream face.
CONCRETE 1:3:6. 145# PER CU. FT.
WATER 62.4# PER CU. FT.
Radius
Elev 724.0
APPROVED
BOSTON
CATSKILL POWER CORP
RIO DEVELOPMENT
STRESS SHEET

PHOTOGRAPHS

APPENDIX B

2. VIEW OF UPSTREAM SLOPE FROM RIGHT ABUTMENT

3. VIEW OF UPSTREAM SLOPE FROM LEFT ABUTMENT

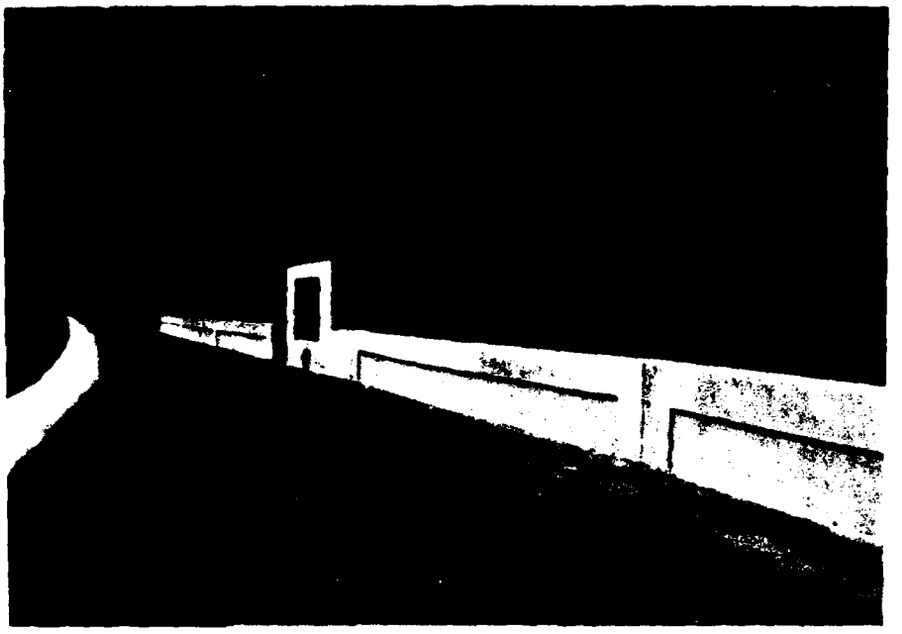


4. VIEW OF DAM CREST FROM CENTER LOOKING TOWARDS RIGHT ABUTMENT

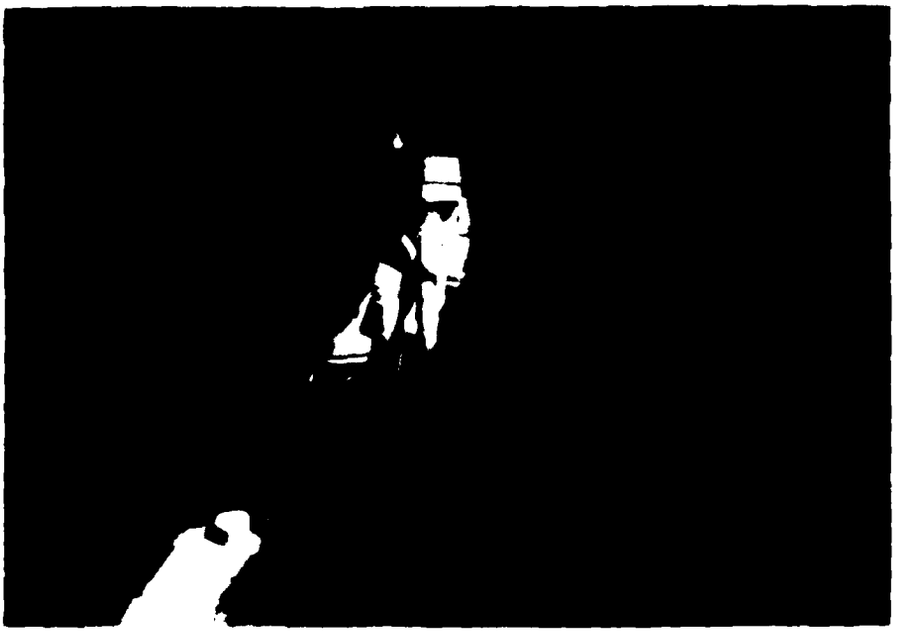
5. VIEW OF DAM CREST FROM CENTER LOOKING TOWARDS LEFT ABUTMENT

6. VIEW OF SPILLWAY FROM DOWNSTREAM RIGHT ABUTMENT (NOTE CHANGE IN PENSTOCK FROM STEEL PIPE TO WOOD STAVE SECTION)

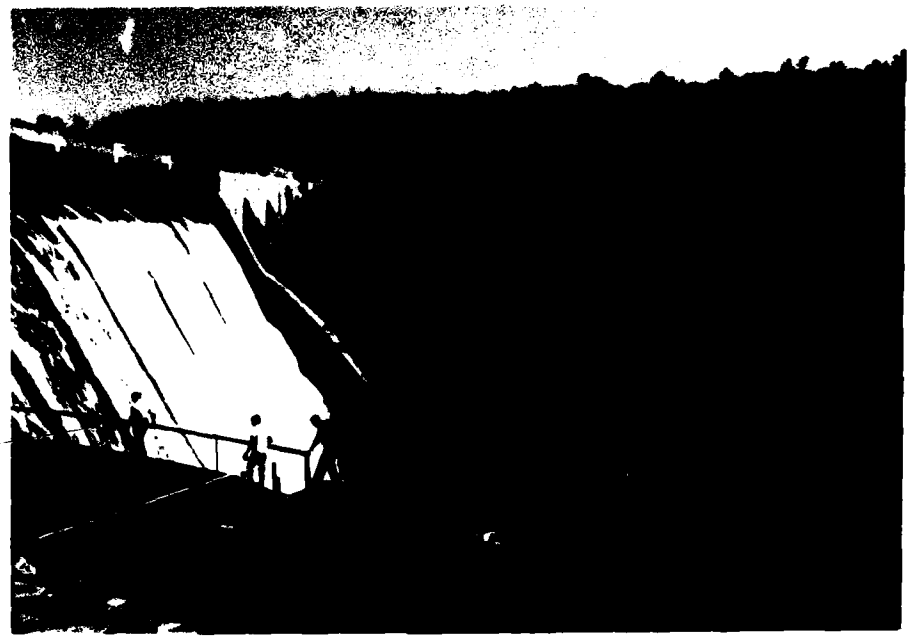
7. VIEW OF RIVER CHANNEL IMMEDIATELY DOWNSTREAM OF SPILLWAY



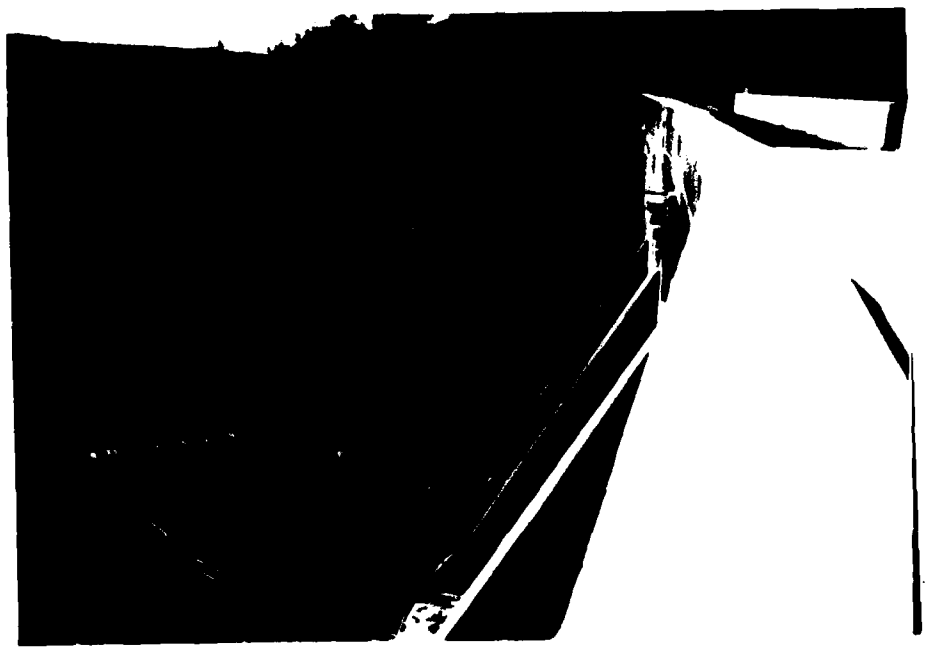
8. GATEHOUSE LOCATED NEAR RIGHT SPILLWAY ABUTMENT



9. SLIDING GATE VALVE CONTROLS LOCATED IN GATEHOUSE



10. VIEW OF DOWNSTREAM LEFT ABUTMENT



11. VIEW OF DOWNSTREAM RIGHT ABUTMENT

12. PENSTOCK DRAIN VALVE LOCATED IMMEDIATELY UPSTREAM OF STEEL/WOOD STAVE PIPE TRANSITION

13. WEIR LOCATED ON DRAINAGE DITCH IMMEDIATELY DOWNSTREAM OF DAM TOE ON LEFT ABUTMENT-USED TO MONITOR FLOW FROM SPRING

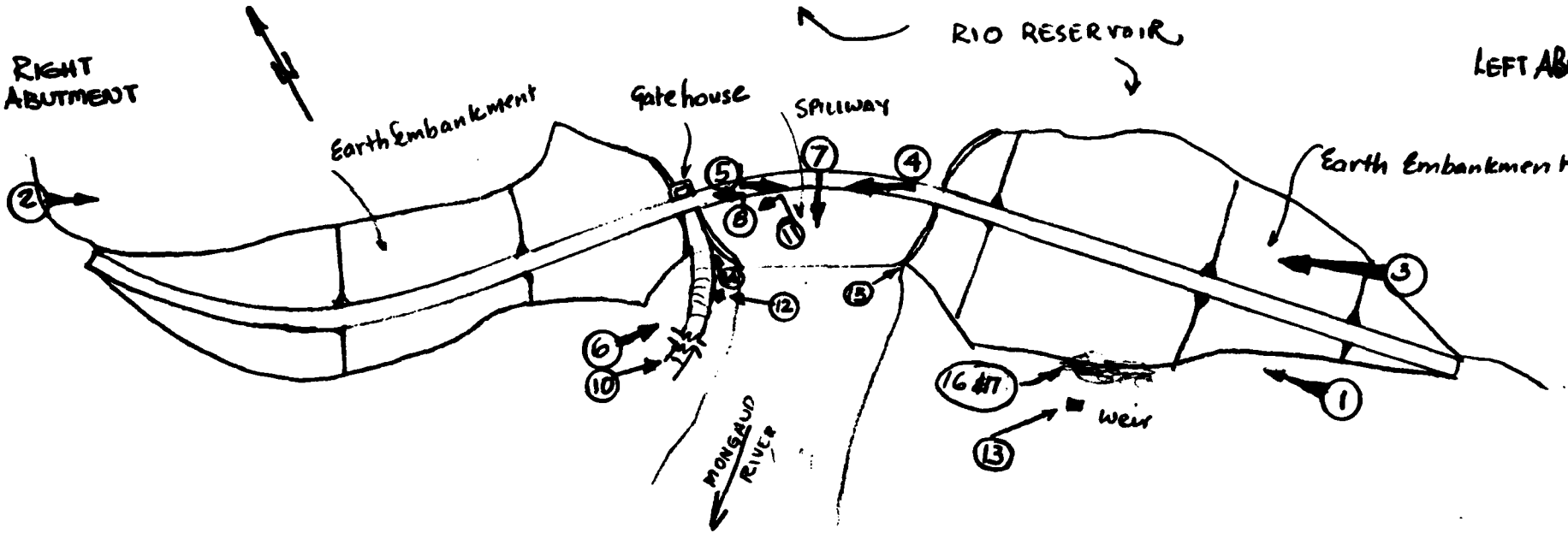
14. DOWNSTREAM JUNCTION OF STEEL PENSTOCK AND SPILLWAY ABUTMENT WALL (NOTE SEEPAGE AROUND PIPE)

15. DOWNSTREAM TOE OF SPILLWAY CHUTE AT LEFT ABUTMENT (NOTE SEEPAGE ENTERING FROM BEHIND WING WALL)

16. TOE OF DAM NEAR TERMINATION OF SPILLWAY LEFT ABUTMENT CUT OFF WALL (NOTE SURFACE WATER)

17. CLOSE-UP OF DAM TOE AS SHOWN IN PHOTOGRAPH 16 (NOTE WATER EMANATING FROM RIPRAP AT TOE)

Photograph 9 taken inside the gate house



Note
Locations of Photographs are approximate.

Scale
NTS

RIO DAM
PHOTOGRAPHS LOCATION PLAN.

VISUAL OBSERVATION

APPENDIX C

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam RIO DAM

Fed. I.D. # NY00497 DEC Dam No. 149B-86

River Basin DELAWARE RIVER BASIN

Location: Town UPPER MONGAUP County ORANGE and Sullivan

Stream Name MONGAUP RIVER

Tributary of DELAWARE RIVER

Latitude (N) 41°-28.8' Longitude (W) 74° 45 4'

Type of Dam EARTH WITH CONC. SPILLWAY

Hazard Category HIGH (1)

Date(s) of Inspection 8 JULY 1981

Weather Conditions Sunny - 85°-95°F.

Reservoir Level at Time of Inspection El. 811.20

b. Inspection Personnel HARVEY S. FELDMAN; JYOTINDRA PATEL; AND JOHN WALLACE

c. Persons Contacted (Including Address & Phone No.) Mr. DONALD LAVERS, SUPERVISOR & INCHARGE OF ENGINEERING; & Mr ROY WANVIG, SENIOR CIVIL ENGINEER

ADDRESS: ORANGE AND ROCKLAND UTILITIES INC.
ONE BLUE HILL PLAZA
PEARL RIVER, NEW YORK 10965

TELEPHONE: (914) 352-6000
914-627-2648 (Direct dial Number of Mr. WANVIG.)

d. History:

Date Constructed 1926-1927 Date(s) Reconstructed 1979 (Roadway spanning the Spillway reconstructed)

Designer { CHARLES H. TENNEY & CO, ENGINEERS BOSTON, MASS
CHAS. T. MAIN, Inc. Boston, Massachusetts.

Constructed By FRED T LEY & CO. Springfield, Massachusetts.

Present Owner ORANGE AND ROCKLAND UTILITIES INC.

2) Embankment LEFT AND RIGHT EMBANKMENTS including Spillway abutment walls.

a. Characteristics

(1) Embankment Material Embankment portions consists of gravel & sand and at abutment walls is riprap.

(2) Cutoff Type Embankment – Core consisting clay and fine sand. Abutment wall – Concrete wall

(3) Impervious Core Only in the embankment portion

(4) Internal Drainage System 8" porous tile drain, laid in gravel immediately downstream of cut off along entire base of spillway abutment walls

(5) Miscellaneous 8" tile drain connected to intermittently spaced 6" tile blanket lines existing near downstream toe of spillway

b. Crest – serves as a roadway. – Spillway – concrete pavement abutments & embankment – Asphalt.

(1) Vertical Alignment Generally good

(2) Horizontal Alignment Curved and alignment generally good.

(3) Surface Cracks Asphalt portion of pavement (embankments) minor cracks – hairline size

(4) Miscellaneous The concrete pavement spanning the spillway repaired recently – repaired section appears to be good.

c. Upstream Slope

(1) Slope (Estimate) (V:H) 1(V) : 3(H) – embankments & abutment wall section.

(2) Undesirable Growth or Debris, Animal Burrows minor vegetation; Debris & animal burrows – none observed

(3) Sloughing, Subsidence or Depressions none observed

(4) Slope Protection rip rap appears to be in good condition (above reservoir level)

(5) Surface Cracks or Movement at Toe none observed above level. Toe of U/S face submerged. Therefore condition could not be ascertained

d. Downstream Slope

(1) Slope (Estimate - V:H) 1(V) : 2(H) – abutment walls & embankment

(2) Undesirable Growth or Debris, Animal Burrows overgrown with grass, shrubs, and small trees.

(3) Sloughing, Subsidence or Depressions None observed

(4) Surface Cracks or Movement at Toe no cracks visible. There appears to be no movement at Toe

(5) Seepage At three locations; two locations on the left embankment; and third at contact between spillway training wall and left abutment wall fill (downstream side.) see attached sketch Sheet 3A

(6) External Drainage System (Ditches, Trenches; Blanket) Along the toe of the left embankment, flow from the seepages at the left embankment is collected in the ditch which runs along the toe of the dam. There are no other drainage system (external)

(7) Condition Around Outlet Structure There is no outlet structure.

(8) Seepage Beyond Toe Flow from a natural spring is collected in a ditch which joins the seepage ditch at left embankment

e. Abutments - Embankment Contacts

The flow from natural spring is measured by the weir and the combined flow is measured by another weir located at the bank of the downstream channel (see sketch on Sheet 3A)

Both embankments – one contact is natural ground and the other is with spillway abutment wall

(1) Erosion at Contact None observed

(2) Seepage Along Contact At Contact between spillway and left abutment wall fill (downstream side) - seepage occuring at downstream end of the downstream training wall. (See also 2.d.5)

3) Drainage System

a. Description of System** In the abutment walls of the spillway section, 8" perous tile drain, placed in gravel. The drains along the downstream face of the cut off wall. and form the drainage system of the spillway which consist of the longitudinal and transverse tile drains **1

b. Condition of System Could not be observed because tile drain are subsurface.

c. Discharge from Drainage System could not be observed at the spillway because spillway was flowing.

4) Instrumentation (Momumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.)

2 Weirs located in the ditches which collect flow from the seepage occuring at the downstream face of the dam (inviscinity of toe) and from the natural spring located at left abutment. In addition to weirs there is pipe which also measures flow which is due to seepage from the exposed rock at left bank of the downstream channel. (See attached sketch sheet 3A)

** Description of System - continued. The transverse drains run at the bottom of the spillway weir and existing at the downstream of the spillway apron into natural channel.

5) Reservoir

a. Slopes Visible slopes in vicinity of the dam are in generally stable condition.

b. Sedimentation Lake water is clear in the vicinity of of dam and there appears to be no sedimentation problems

c. Unusual Conditions Which Affect Dam none observed.

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.)

b. Seepage, Unusual Growth No seepage observed except in the vicinity of the spillway - from exposed rock

c. Evidence of Movement Beyond Toe of Dam none

d. Condition of Downstream Channel good except minor floating debris

7) Spillway(s) (Including Discharge Conveyance Channel)

a. General The concrete spillway is located at about center of the dam. The spillway consists of 8 (eight) overflow section each about 33 feet span. Total length 264 ft. spanning the spillway is a concrete roadway which is supported by five 7 piers equally spaced along the spillway crest; the discharges over the spillway are controlled by flashboards which drop out of position after lake reaches a certain stage. The spillway is founded on bedrock and the downstream channel is bedrock formed. The surface of the spillway is gunited

b. Condition of Service Spillway The concrete spillway appears to be in good condition except minor spalling of the concrete especially at downstream training walls. At the non overflow section of downstream face (above penstock inlet) few inches of concrete surface is removed. It is reported that this section will be resurfaced the scaffold used during the repair work of roadway still in place at this section. (see structural comments)

c. Condition of Auxiliary Spillway There is no auxiliary spillway

d. Condition of Discharge Conveyance Channel good except minor floating debris the exposed slopes which are rock formed are stable

8) Reservoir Drain/Outlet There is no reservoir Drain. *
powerhouse pipe system

Type: Pipe X Conduit _____ Other _____

Material: Concrete _____ Metal Steel & Other wood stave pipe

Size: 11.0' wood / 10'-7' steel Length 7075 wood stave / 450' steel penstock

Invert Elevations: Entrance 769.5 Exit 630 ±

Physical Condition (Describe): Unobservable ✓

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

_____

Hydraulic Capability: _____

_____

Means of Control: Gate X Valve _____ Uncontrolled _____

Operation: Operable Reportedly Inoperable _____ Other _____

Present Condition (Describe): was not operated at time of site visit nor within past 2 yrs. Reportedly in good condition

There is a power plant intake located at the right abutment of the spillway having an invert El 769.5 that may be used in an emergency as a partial reservoir drain

9) Structural Concrete Spillway and Spillway Abutment walls.

a. Concrete Surfaces Since the discharges were flowing over the Spillway, the condition of concrete surface of the Spillway could not be ascertained. The condition of the concrete surface at the abutment walls are good.

b. Structural Cracking Several horizontal cracks at downstream face of the Spillway. Cracks appears to be at the gunite surface joints.

c. Movement - Horizontal & Vertical Alignment (Settlement) None observed.

d. Junctions with Abutments or Embankments The spillway and the abutment walls are tied well with the both embankments. There is seepage occuring at the left spillway/abutment contact as described below

e. Drains - Foundation, Joint, Face According to drawings longitudinal and transverse tile drains at the bottom of the Spillway section; and longitudinal drain at abutment walls. None could be located (See Drainage System Item # 3)

f. Water Passages, Conduits, Sluices CONSTRUCTION DRAWING shows the presence of a bypass tunnel located at the base of the dam w/ flow controlled by a temporary sluice. Tilting shutters are shown. This tunnel has apparently been filled at the conclusion of dam construction

g. Seepage or Leakage Minor amounts of seepage was observed from at the toe of the spillway on the left abutment. Seepage waters were observed exiting from joints in the foundation rock immediately downstream of the left abutment spillway training wall. Minor seepage was observed where the power plant pipeline exited the downstream face of the spillway Right abutment

h. Joints - Construction, etc. Appear in good condition

i. Foundation The concrete spillway section is founded on competent sandstone and shale bedrock

j. Abutments Appear in good condition

k. Control Gates were not operated at time of inspection but were reported operable by owners representative

l. Approach & Outlet Channels good condition

m. Energy Dissipators (Plunge Pool, etc.) -none-

n. Intake Structures -not observed-

o. Stability Appears in stable condition

p. Miscellaneous

10) Appurtenant Structures (Powerhouse, Lock, Gatehouse, Other)

a. Description and Condition

Powerhouse which is located several miles d/s. The penstock from the dam connects the powerhouse. It is reported that the several segments of penstock are damaged. The gatehouse appears to be in good condition.

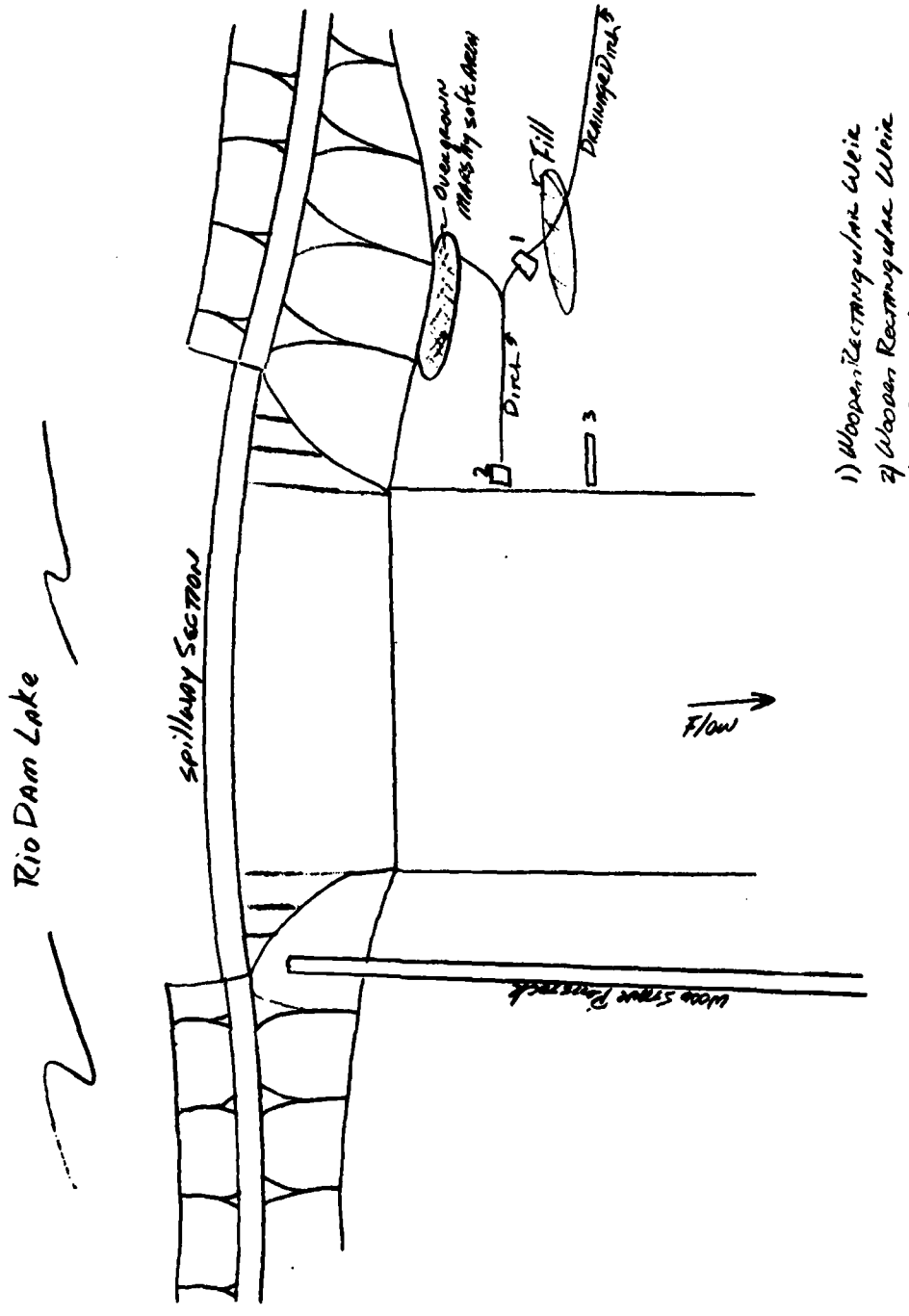
TAMS

Job No. 1579-19 Sheet 10 of _____

Project NYS Dam Inspection Date 7-29-81

Subject Rio Dam NY00497 By JFW

Site Plan View Showing Areas of Interest From Site Visit Ch'k. by _____



HYDROLOGIC DATA & COMPUTATIONS

APPENDIX D

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

	Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1) Top of Dam	825.0	540	19978
2) Design High Water (Max. Design Pool) (shown on the drawings)	822.0	508	18398
3) Auxiliary Spillway Crest	None	—	—
4) Pool Level with Flashboards	815.0	428	15105
5) Service Spillway Crest	810.0	370	13110

DISCHARGES

	Volume (cfs)
1) Average Daily	UNKNOWN
2) Spillway @ Maximum High Water	62090
3) Spillway @ Design High Water	41500
4) Spillway @ Auxiliary Spillway Crest Elevation	—
5) Low Level Outlet	UNKNOWN
6) Total (of all facilities) @ Maximum High Water	62090+
7) Maximum Known Flood	
8) At Time of Inspection	UNKNOWN

EMBANKMENT

CREST: ELEVATION: 825.0'

Type: EARTH fill

Width: 20.0' Lengt': 1487' including spillway

Spillover Controlled Concrete Spillover section

Location Spillover section located in center of Dam

SPILLWAY:

SERVICE		AUXILIARY
810.0	Elevation	NONE
OVER FLOW SECTION	Type	—
264 ft	Width	—
	Type of Control	
—	Uncontrolled	—
	Controlled:	
FLASH BOARDS	Type (Flashboards; gate)	—
5	Number	—
12" / 30ft	Size/Length	—
	Invert Material	—
	Anticipated Length of operating service	
150't	Chute Length	
—	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	

HYDROMETEROLOGICAL GAGES:

Type : _____

Location: _____

Records:

Date - _____

Max. Reading - _____

FLOOD WATER CONTROL SYSTEM:

Warning System: Observation and Reporting in the form of an Emergency Action Plan

Method of Controlled Releases (mechanisms):

None currently active - inoperative penstock could be used if repaired

DRAINAGE AREA: 202 square miles

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: forest land, urban, suburban & rural

Terrain - Relief: gently to steeply sloping

Surface - Soil: Residual & glacial

Runoff Potential (existing or planned extensive alterations to existing (surface or subsurface conditions)

unknown

Potential Sedimentation problem areas (natural or man-made; present or future)

unknown

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

none

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

Location: unknown

Elevation:

Reservoir:

Length @ Maximum Pool 0.74 (Miles)

Length of Shoreline (@ Spillway Crest) 8.05 (Miles)

TAMS

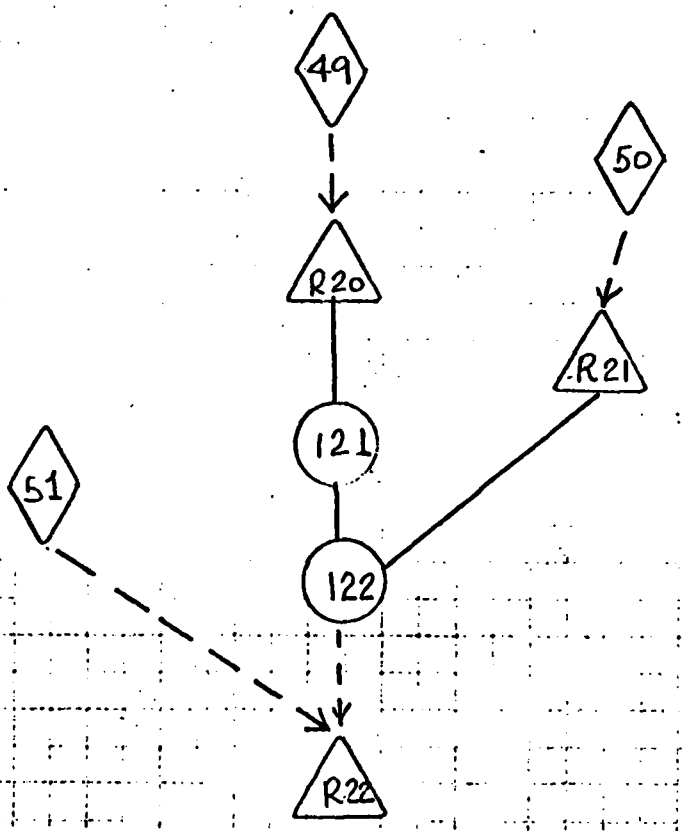
Job No. 1579-19 Sheet 1 of 9

Project RIO DAM PHASE 1 SAFETY INSPECTION Date JULY 23, 198

Subject HYDROLOGIC / HYDRAULIC COMPUTATIONS By D.L.C

Ch'k. by

FROM: UPPER DELAWARE RIVER BASIN HYDROLOGIC FLOOD ROUTING MODEL. (REF 2)



MONGOUP RIVER BASIN TO RIO RESERVOIR AND DAM.

R 20 TORONTO RESERVOIR

R 21 SWINGING BRIDGE RESERVOIR

R 22 RIO RESERVOIR

TAMS

Job No. 1579-19 Sheet 2 of 9
Project RIO DAM Date AUG 21, 1981
Subject HYDROLOGIC / HYDRAULIC COMPUTATIONS By D.L.C.
Ch'k. by

BASIN AREA 202 SQ MILES (REF 2)

① TORONTO RESERVOIR SUBAREA 23.2 SQ MILES
② SWINGING BRIDGE RES. SUBAREA 118.0 SQ MI
③ RIO RESERVOIR SUBAREA 60.8 SQ MI

FROM HMR 33 ZONE 1
ALL SEASON 200 SQMI 24HR PMP = 21.0"

DURATION (HRS)	% DEPTH ①	②	③
6	102	82	88
12	114	96	104
24	124	107	114
48	134	112	120

TOP OF DAM PARAPET 829.0'
TOP OF ROAD OVER SPILLWAY 825.0'
LOWCORD " " " " 823.9'

TAMS

Job No. 1579-19 Sheet 3 of 9
Project Rio DAM Date July 23, 81
Subject HYDROLOGIC & HYDRAULIC COMPUTATIONS By DLC
Ch'k. by

SUBBASIN CHARACTERISTICS and UNIT HYDROGRAPHS

Subbasin	49	50	51
Drainage Area (sq mi)	23.2	118.0	60.8
Length (mi)	9.9	14.4	6.3
Slope (ft/ft)	0.0057	0.0066	0.0150

Hours	Discharge (cfs)		
0	0	0	0
3	499	2,537	2,876
6	1,347	5,327	3,660
9	848	4,440	2,222
12	647	3,425	1,438
15	499	2,664	1,046
18	349	1,903	719
21	224	1,395	458
24	155	1,015	261
27	120	761	157
30	100	533	118
33	75	381	65
36	50	304	52
39	40	254	0
42	35	203	
45	0	127	
48		101	
51		0	
54			

TAMS

Job No. 1579-19 Sheet 4 of 9
Project RIO DAM. Date JULY 23, '81
Subject HYDROLOGIC / HYDRAULIC COMPUTATIONS By D L C
Ch'k. by

MODELING PARAMETERS

SUBBASIN	QRCSN[1] Ratio	RTIOR[2]	1950 INITIAL BASE FLOW (cfs/sq mi)	1950 LOSSES INITIAL (in.)	1950 LOSSES CONSTANT (in./hr)	1955 X INITIAL BASE FLOW (cfs/sq mi)	1955 X LOSSES INITIAL (in.)	1955 X LOSSES CONSTANT (in./hr)
49	0.55	4.30	0.80	2.00	0.17	0.80	2.00	0.30
50	0.46	3.70	0.80	2.10	0.14	0.80	2.00	0.13
51	0.49	4.00	0.80	2.10	0.14	0.80	2.00	0.25

RESERVOIR DISCHARGE RATINGS

SWINGING BRIDGE

Spillway Crest Elevation = 1,065 ft
Storage at Spillway Crest Elevation = 28,060 acre ft

Storage (acre ft)	Discharge (cfs)
7,820	457
28,060	1,076
28,980	1,576
29,900	2,176
30,820	2,876
31,740	3,876
32,890	4,876
33,580	6,576
34,500	8,776
35,420	24,776

TORONTO

Spillway Crest Elevation = 1,215 ft
Storage at Spillway Crest Elevation = 21,850 acre ft

Storage (acre ft)	Discharge (cfs)
21,850	0
23,230	420
23,920	800
24,610	1,230
25,300	1,780
25,990	2,350
26,680	2,950
27,370	3,600
28,060	4,300
28,750	5,000

TAMS

Job No. 1579-19 Sheet 5 of 9
Project RIO DAM Date JULY 23, 8
Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS. By D.L.C.
Ch'k. by

SPILLWAY CONSISTS of 8 bays 30.0' wide

ASSUME H_D = (DESIGN HEAD) = 12.0'

El	H_c	H_c/H_D	C	Q_1	Q_8	
810	0					
815	5			0	0	TOP OF FLASHBOARDS
817	(2)		3.3	280	2240	Just prior to tripping of flashboards
818	8	0.67	3.8	2579.5	20636.	
890	10	0.83	3.91	3709.4	29675.2	
822.	12	1.00	4.02	5013.2	40105.6	
823.9	13.9	1.16	4.12	6405.3	51242.4	LOW CORD ROADWAY
825				7761.4	62090	
829				9505.7	76045.5	Pressure flow $Q = 0.82\sqrt{\frac{1}{0}}\sqrt{H_c}$

AREA UNDER RD - 1 SPAN = 30 x 13.9 = 417 sq ft

H_c = 829 - 817 = 12.0'

$Q = (0.82)(\sqrt{64.4})(\sqrt{12})(417)$

$= (2744.055)\sqrt{H}$ = 9505.7

H is assumed flashboard are in place — Q at El 817 is over flashboards (which act as sharp crested weir) — flashboards are tripped as reservoir surface rises above El 817 (20 feet above top of flashboards.

TAMS

Job No. 1579-19
Project RIO DAM
Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS

Sheet 6 of 9
Date July 29, 81
By DLC
Ch'k. by

Flow over bridge parapet L = 465'

EL.	H	C	Q	Use C = 2.6 $Q_{S.}$ (Pressure flow)	Q_{TOTAL}
829	0		0		
830	1.	2.6	1209	79150.	80359
832	3	2 6	6282	85022	91304

Pressure flow under rd. $Q = CA\sqrt{2g}\sqrt{H} = (2744.055)\sqrt{H}$

Area of 1 span = 417 sqft

AT 830 H = 830-817 = 13.0' C = 0.52

$Q = (2744.055)\sqrt{13} = 9893.8$ cfs

AT 832 H = 15.

$Q = (2744.055)\sqrt{15} = 10,627.7$ cfs.

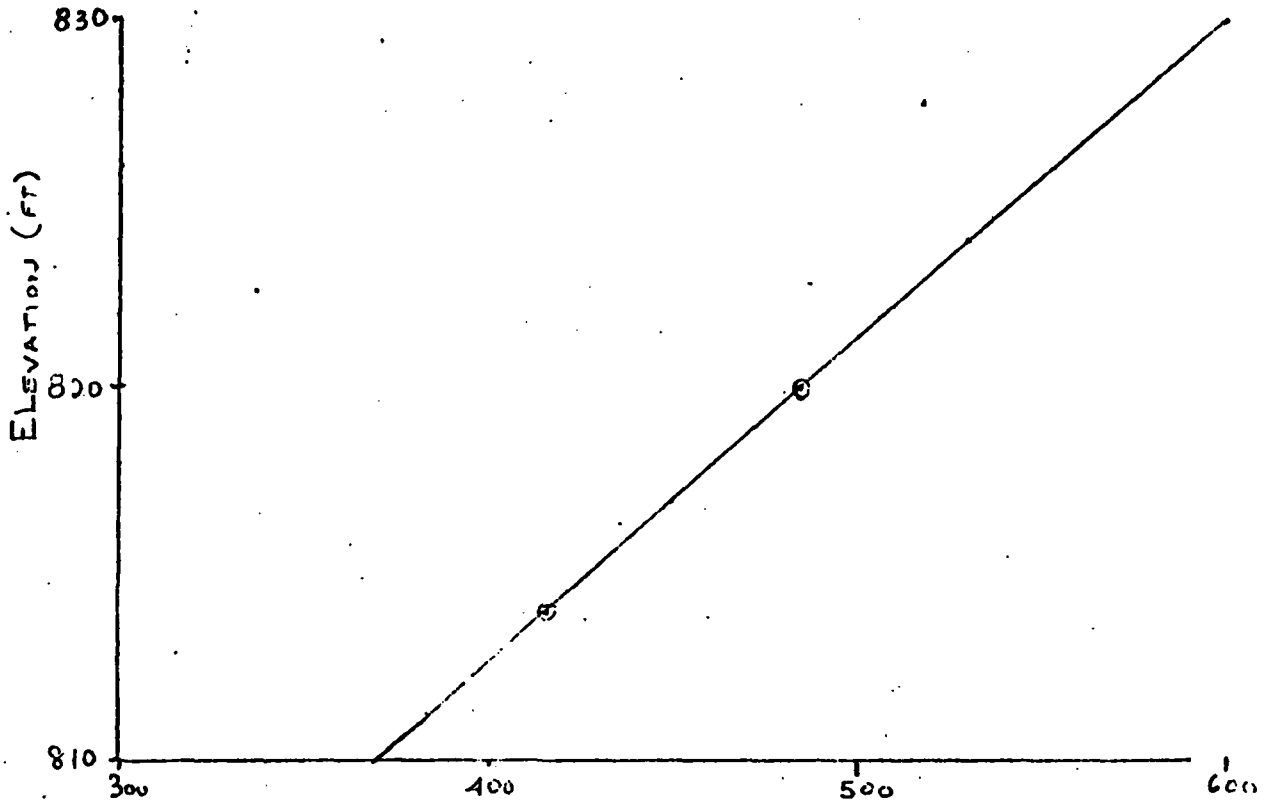
SPILLWAY RATING TABLE

EL	Q	
810	0	
815	0	
817	2240	
818	20636	
823.9	51242	Low cord
825.	62090	Top of Dam.
829	76045	Top of Parapet
830	80359	} Flow over 465' parapet
832	91304	} + pressure flow

TAMS

Job No. 1579.19
Project RIO DAM
Subject HYDROLOGIC/HYDRAULIC COMPUTATIONS.

Sheet 7 of 9
Date JULY 24, 1981
By D L C
Ch'k. by



EL	ΔH	AREA	MEAN AREA	INC. VOL	STORAGE
810		370			13110
	5		399	1995	
815		428			15105
	2		439	878	
817		450			15983
	3		467.15	1401.5	
820		484.3			17384.5
	4		507.15	2028.6	
824		530			19413.1
	6		565	3390	
830		600			22803.1

AREA extrapolated as shown above - increase assumed linear

TAMS

Job No. _____ Sheet 8 of 9

Project Rio Dam. Date July 28, 1961

Subject Hydrologic / Hydraulic Computations By D.L.C.

Extrapolation Storage / Discharge Swinging Bridge Ch'k. by _____

Discharge. Using Manning Formula for open channel

Width = 325

Slope = 0.01 ft/ft

at El 1072.5 H = 7.5. use n = 0.035

$A = 2437.5$ $P = 340$ $R = 7.17$ $R^{2/3} = 3.72$

$Q = \left(\frac{1.49}{0.035}\right)(2437.5)(\sqrt{0.01})(3.72)$

$= 38,600$ cfs

at El 1080 top of dam

Use n = 0.035

$A = 4875$ $P = 355$ $R = 13.73$ $R^{2/3} = 5.73$

$Q = \left(\frac{1.49}{0.035}\right)(5.73)(4875)(\sqrt{0.01}) =$

$= 118,900$ cfs

From Phase 1 Report

El	Storage
1065	27000
1070	32000
1073	38500

assuming linear increase in storage.

1072.5	37420
1080	53670

TAMS

Job No. 1579-19 Sheet 9 of 9
Project Rio Reservoir (Mongaup River) Date 7/81
Subject By JMD
Ch'k. by

FETCH: 0.74 mi. (1.95")

PERIMETER (@ EL. 814): 21.25" = 8.05 mi.

LAKE AREA (@ EL. 814):

2.15	HIGHLAND LAKE QUAD	2.40	POND EDDY QUAD
2.11		2.42	
2.14		2.42	
2.12			

avg = 2.13 in² avg 2.4133 in²

195.6 acres + 221.6 acres = 417.2 acres
= 0.65 sq mi.

CONTOUR (@ EL. 820):

2.53	HIGHLAND LAKE	2.80	POND EDDY
2.47		2.78	
2.45		2.78	
2.50			

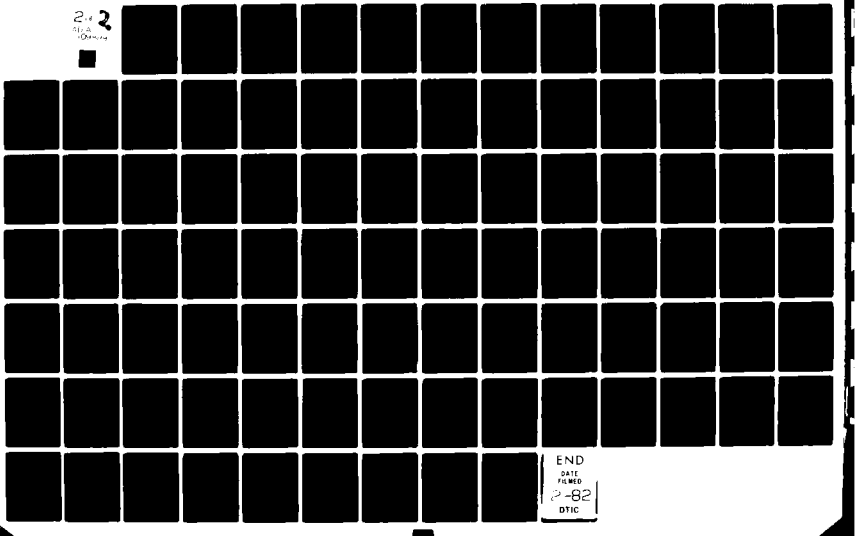
avg = 2.4875 in² avg = 2.7867 in²

228.4 acres + 255.9 acres = 484.3 acres
= 0.76 sq. mi.

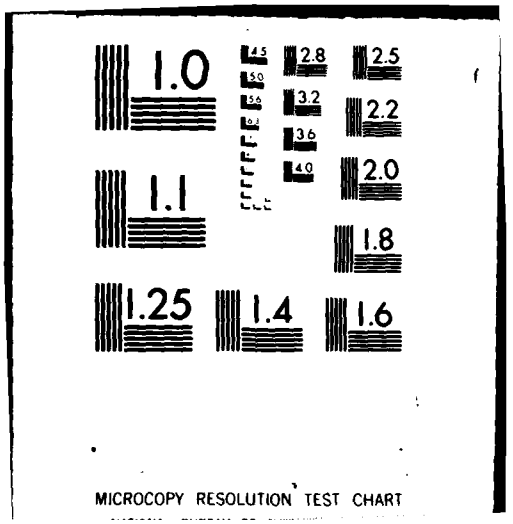
DRAINAGE AREA: 202 SQ MI (REF 2)

AD-A109 899 TIPPETTS-ABBETT-MCCARTHY-STRATTON NEW YORK F/G 13/13
NATIONAL DAM SAFETY PROGRAM. RIO DAM (INVENTORY NUMBER NY 497).--ETC(U)
SEP 81 E O'BRIEN DACW51-81-C-0008

UNCLASSIFIED NL



END
DATE FILMED
2-82
DTIC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART

CASE A

NO FLASHBOARDS AT
BEGINNING OF FLOOD
ROUTING (Sheets 1 of 28
thru 28 of 28)

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
**********
     1  A1
     2  A2                                   RIO DAM PHASE 1 SAFETY INVESTIGATION
     3  A3                                   HEC 1 DB  PMF ANALYSIS
     4  B      50         3                  JULY 1981
     5  B1      5
     6  J       1         4         1
     7  J1      1      0.75       0.5      0.25
     8  K                 1                                                    1
     9  K1                49 TORONTO SUB-AREA RUNOFF
    10  M       1                 -1      23.2                    202
    11  P                         21       102       114       124       134                                    1
    12  T
    13  U      15                                                                          2       .3
    14  U1    499      1347       848       647       499       349       224       155       120       100
    15  U1     75        50        40        35
    16  X     -.8      -.55       4.3
    17  K       1       121                                                          1
    18  K1                R2U ROUTE THRCUGH TORONTO RESERVOIR
    19  V                                             1         1
    20  Y1      1                                                                                21850
    21  Y2  21850     23920     25300     27370     28750     32000
    22  Y3      0       800      1780      3600      5000     10000
    23  K       3         2                                                          1
    24  K1                50 SWINGING BRIDGE SUB-AREA RUNOFF
    25  M       1                 -1       118                    202
    26  P                         21        82        96       107       112                                    1
    27  T
    28  U      17                                                                          2      0.13
    29  U1   2537      5327      4440      3425      2664      1903      1395      1015       761       533
    30  U1    381       304       254       203       127       101
    31  X     -.5      -.46       3.7
    32  K       1       122                                                          1
    33  K1                R21 ROUTE THROUGH SWINGING BRIDGE RESERVOIR
    34  V                                             1         1
    35  Y1      1                                                                                28060
    36  Y2   7820     27200     37420     53670
    37  Y3    457      1076      3600    118900
    38  K       2         3                                                          1
    39  K1                100 COMBINE HYDROGRAPHS 121 & 122
    40  K       0         4                                                          1
    41  K1                51 RIO RESERVOIR SUBAREA INFLOW
    42  M       1                 -1      60.8                    202
    43  P                         21        88       104       114       120                                    1
    44  T
    45  U      13                                                                          2       .25
    46  U1   2876      3660      2222      1438      1046       719       458       261       157       118
    47  U1     65        52
    48  X     -.8       .49         4
    49  K       2         5                                                          1
    50  K1                101 COMBINE HYDROGRAPH AT 6 WITH RIO INFLOW
```

CASE A.
no flashboards on spillway crest.

sheet 1 of 28

Job No. _____ Sheet _____ of _____
Project _____
Sul _____ Date _____

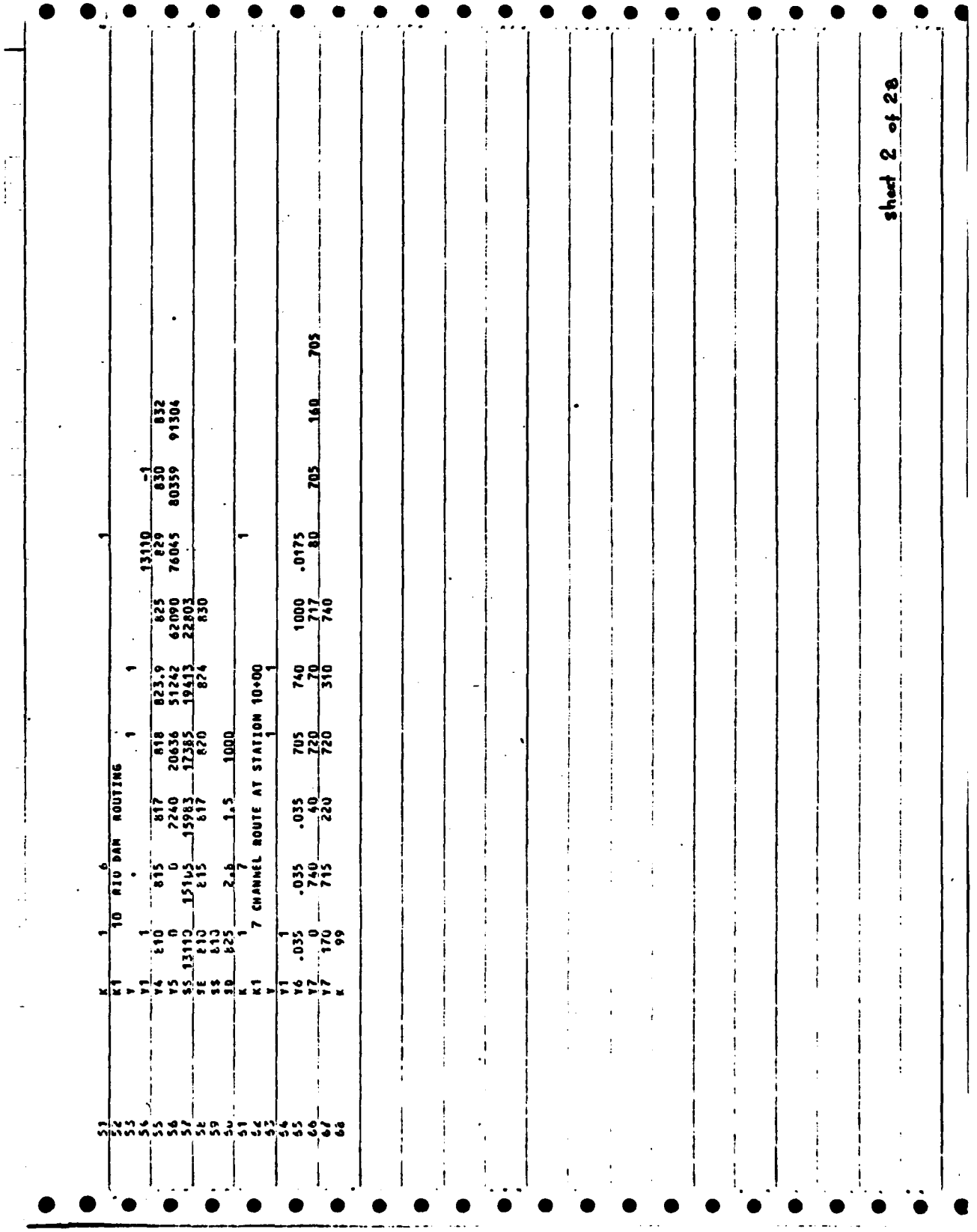
TAMS

TAMS

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____ By _____



PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	121
RUNOFF HYDROGRAPH AT	2
ROUTE HYDROGRAPH TO	122
COMBINE 2 HYDROGRAPHS AT	3
RUNOFF HYDROGRAPH AT	4
COMBINE 2 HYDROGRAPHS AT	5
ROUTE HYDROGRAPH TO	6
ROUTE HYDROGRAPH TO	7

END OF NETWORK

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
**********

RUN. DATE= 81/12/23.
     TIME= 12.56.57.

                    RIO DAM PHASE 1 SAFETY INVESTIGATION
                    HEC 1 DB. PMF ANALYSIS
                    JULY 1981

                              JOB SPECIFICATION
      NQ     NHR    NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
      50       3       0       0       0       0       0       0       0       0
                           JOPER     NWT   LROPT   TRACE
                               5       0       0       0

                    MULTI-PLAN ANALYSES TO BE PERFORMED
                    NPLAN= 1 NRTIO= 4 LRTIO= 1
          RTIOS=   1.00     .75     .50     .25

**********  **********  **********  **********  **********

                    SUB-AREA RUNOFF COMPUTATION

          49 TORONTO SUB-AREA RUNOFF

                ISTAQ   ICOMP   IECON   ITAPE   JPLT    JPRT   INAME  ISTAGE  IAUTO
                    1       0       0       0       0       0       1       0       0

                              HYDROGRAPH DATA
          IHYDC    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
              1      -1   23.20    0.00  202.00    0.00   0.000       0       1       0

                              PRECIP DATA
            SPFE     PMS      R6     R12     R24     R48     R72     R96
            0.00   21.00  102.00  114.00  124.00  134.00    0.00    0.00
 TRSPC COMPUTED BY THE PROGRAM IS  .893

                              LOSS DATA
      LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
          0    0.00    0.00    1.00    0.00    0.00    1.00    2.00     .30    0.00    0.00

                    GIVEN UNIT GRAPH, NUHGQ=  15
      499.    1347.     848.     647.     499.     349.     224.     155.     120.     100.
       75.      50.      40.      35.       0.
                    UNIT GRAPH TOTALS   4988. CFS OR 1.00 INCHES OVER THE AREA

                              RECESSION DATA
                    STRTQ=    -.80    QRCSN=    -.55    RTIOR= 4.30

                              END-OF-PERIOD FLOW
 MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q      MO.DA  HR.MN  PERIOD   RAIN   EXCS   LOSS   COMP Q
```

Sheet 4 of 28

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____ By _____

TAMS

1.01	3.00	1	.03	0.00	.03	16.	1.04	6.00	26	0.00	0.00	0.00	2930.
1.01	6.00	2	.03	0.00	.03	14.	1.04	9.00	27	0.00	0.00	0.00	2533.
1.01	9.00	3	.09	0.00	.09	12.	1.04	12.00	28	0.00	0.00	0.00	2189.
1.01	12.00	4	.09	0.00	.09	10.	1.04	15.00	29	0.00	0.00	0.00	1892.
1.01	15.00	5	.50	0.00	.50	9.	1.04	18.00	30	0.00	0.00	0.00	1635.
1.01	18.00	6	1.02	0.00	1.02	8.	1.04	21.00	31	0.00	0.00	0.00	1413.
1.01	21.00	7	.04	0.00	.04	7.	1.05	0.00	32	0.00	0.00	0.00	1221.
1.02	0.00	8	.04	0.00	.04	6.	1.05	3.00	33	0.00	0.00	0.00	1056.
1.02	3.00	9	.37	0.00	.37	5.	1.05	6.00	34	0.00	0.00	0.00	912.
1.02	6.00	10	.37	0.00	.37	4.	1.05	9.00	35	0.00	0.00	0.00	788.
1.02	9.00	11	1.11	.21	.90	110.	1.05	12.00	36	0.00	0.00	0.00	681.
1.02	12.00	12	1.11	.21	.90	395.	1.05	15.00	37	0.00	0.00	0.00	589.
1.02	15.00	13	6.24	5.34	.90	3132.	1.05	18.00	38	0.00	0.00	0.00	509.
1.02	18.00	14	12.67	11.77	.90	13382.	1.05	21.00	39	0.00	0.00	0.00	440.
1.02	21.00	15	.56	0.00	.56	20621.	1.06	0.00	40	0.00	0.00	0.00	380.
1.03	0.00	16	.56	0.00	.56	13611.	1.06	3.00	41	0.00	0.00	0.00	329.
1.03	3.00	17	0.00	0.00	0.00	10890.	1.06	6.00	42	0.00	0.00	0.00	284.
1.03	6.00	18	0.00	0.00	0.00	9412.	1.06	9.00	43	0.00	0.00	0.00	245.
1.03	9.00	19	0.00	0.00	0.00	8135.	1.06	12.00	44	0.00	0.00	0.00	212.
1.03	12.00	20	0.00	0.00	0.00	7031.	1.06	15.00	45	0.00	0.00	0.00	183.
1.03	15.00	21	0.00	0.00	0.00	6076.	1.06	18.00	46	0.00	0.00	0.00	158.
1.03	18.00	22	0.00	0.00	0.00	5252.	1.06	21.00	47	0.00	0.00	0.00	137.
1.03	21.00	23	0.00	0.00	0.00	4539.	1.07	0.00	48	0.00	0.00	0.00	118.
1.04	0.00	24	0.00	0.00	0.00	3923.	1.07	3.00	49	0.00	0.00	0.00	102.
1.04	3.00	25	0.00	0.00	0.00	3391.	1.07	6.00	50	0.00	0.00	0.00	88.
									SUM	24.94	17.53	7.31	131017.
										(631.)	(445.)	(186.)	(3709.99)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20621.	17059.	10961.	5271.	130966.
CMS	584.	483.	310.	149.	3709.
INCHES		6.84	17.58	25.36	26.26
MM		173.74	446.53	644.19	666.91
AC-FT		8459.	21741.	31365.	32471.
THOUS CU M		10434.	26817.	38688.	40052.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

16.	14.	12.	10.	9.	8.	7.	6.	5.	4.
110.	395.	3132.	13382.	20621.	13611.	10890.	9412.	8135.	7031.
6076.	5252.	4539.	3923.	3391.	2930.	2533.	2189.	1892.	1635.
1413.	1221.	1056.	912.	788.	681.	589.	509.	440.	380.
329.	284.	245.	212.	183.	158.	137.	118.	102.	88.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20621.	17059.	10961.	5271.	130966.
CMS	584.	483.	310.	149.	3709.
INCHES		6.84	17.58	25.36	26.26
MM		173.74	446.53	644.19	666.91
AC-FT		8459.	21741.	31365.	32471.
THOUS CU M		10434.	26817.	38688.	40052.

Sheet 5 of 29

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

12.	10.	9.	8.	7.	6.	5.	4.	4.	3.
82.	296.	2349.	10036.	15466.	10210.	8168.	7059.	6101.	5273.

TAMS

4557.	3938.	3404.	2942.	2543.	2198.	1899.	1642.	1419.	1226.
1060.	916.	792.	684.	591.	511.	442.	382.	330.	285.
246.	213.	184.	159.	138.	119.	103.	89.	77.	66.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15466.	12794.	8221.	3953.	98225.
CMS	438.	362.	233.	112.	2781.
INCHES		5.13	13.18	19.02	19.69
MM		130.30	334.89	483.14	500.18
AC-FT		6344.	16306.	23523.	24353.
THOUS CU M		7826.	20113.	29016.	30039.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

8.	7.	6.	5.	4.	4.	3.	3.	3.	2.
55.	197.	1566.	6691.	10310.	6807.	5445.	4706.	4067.	3515.
3038.	2626.	2269.	1961.	1695.	1465.	1266.	1094.	946.	818.
707.	611.	528.	456.	394.	341.	294.	255.	220.	190.
164.	142.	123.	106.	92.	79.	68.	59.	51.	44.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10310.	8530.	5480.	2635.	65483.
CMS	292.	242.	155.	75.	1854.
INCHES		3.42	8.79	12.68	13.13
MM		86.87	223.26	322.09	333.45
AC-FT		4230.	10870.	15682.	16236.
THOUS CU M		5217.	13408.	19344.	20026.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

4.	3.	3.	3.	2.	2.	2.	1.	1.	1.
27.	99.	783.	3345.	5155.	3403.	2723.	2353.	2034.	1758.
1519.	1313.	1135.	981.	848.	733.	633.	547.	473.	409.
353.	305.	264.	228.	197.	170.	147.	127.	110.	95.
82.	71.	61.	53.	46.	40.	34.	30.	26.	22.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5155.	4265.	2740.	1318.	32742.
CMS	146.	121.	78.	37.	927.
INCHES		1.71	4.39	6.34	6.56
MM		43.43	111.63	161.05	166.73
AC-FT		2115.	5435.	7541.	8118.
THOUS CU M		2609.	6704.	9672.	10013.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

R2U ROUTE THROUGH TORONTO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
121	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR

TAMS

Job No. ________ Sheet ____ of ____

Project ________ Date ________

Subject ________ By ________

Sheet 7 of 28

0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	21850.	0

STORAGE	21850.00	23920.00	25300.00	27370.00	28750.00	32000.00
OUTFLOW	0.00	500.00	1780.00	3600.00	5000.00	10000.00

STATION 121, PLAN 1, RTIO 1

OUTFLOW

1.	3.	4.	4.	5.	5.	5.	5.	5.	5.
10.	32.	193.	1027.	4060.	7835.	9250.	9539.	9294.	8746.
2843.	7281.	6517.	5785.	5103.	4638.	4212.	3798.	3429.	3132.
2791.	2502.	2236.	1988.	1767.	1600.	1444.	1299.	1166.	1043.
932.	831.	746.	717.	669.	624.	580.	539.	499.	463.

STOR

21854.	21857.	21859.	21861.	21862.	21863.	21864.	21864.	21864.	21864.
21876.	21933.	22343.	24239.	27824.	30593.	31513.	31700.	31541.	31185.
30724.	30233.	29736.	29260.	28817.	28393.	27973.	27565.	27175.	26803.
26450.	26121.	25816.	25537.	25282.	25047.	24827.	24623.	24435.	24263.
24106.	23963.	23831.	23704.	23581.	23463.	23351.	23244.	23142.	23047.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9539.	9405.	8185.	4838.	126154.
CMS	270.	266.	232.	137.	3572.
INCHES		3.77	13.13	23.28	25.29
MM		95.79	333.44	591.31	642.41
AC-FT		4664.	16235.	28790.	31278.
THOUS CU M		5753.	20025.	35512.	38581.

MAXIMUM STORAGE = 31700.

STATION 121, PLAN 1, RTIO 2

OUTFLOW

1.	2.	3.	3.	4.	4.	4.	4.	4.	4.
8.	24.	143.	696.	2736.	4875.	6202.	6654.	6631.	6328.
5876.	5354.	4871.	4492.	4101.	3714.	3373.	3058.	2758.	2476.
2214.	1973.	1759.	1593.	1438.	1295.	1162.	1041.	930.	829.
765.	716.	669.	623.	580.	539.	499.	463.	428.	395.

STOR

21853.	21855.	21857.	21858.	21859.	21860.	21860.	21860.	21860.	21860.
21879.	21912.	22220.	23651.	26387.	28626.	29531.	29825.	29810.	29613.
29319.	28983.	28623.	28249.	27864.	27483.	27112.	26754.	26412.	26091.
25793.	25519.	25269.	25036.	24819.	24616.	24430.	24259.	24103.	23961.
23829.	23703.	23580.	23463.	23350.	23243.	23142.	23047.	22957.	22873.

TAMS

Job No. ____________ Sheet ______ of ______

Project ____________ Date ____________

Subject ____________ By ____________

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6654.	6561.	5825.	3575.	94112.
CMS	188.	186.	165.	101.	2665.
INCHES		2.63	9.34	17.20	18.87
MM		66.82	237.30	436.91	479.24
AC-FT		3253.	11554.	21272.	23333.
THOUS CU M		4013.	14251.	26239.	28781.

MAXIMUM STORAGE = 29825.

STATION 121, PLAN 1, RTIO 3

OUTFLOW

1.	1.	2.	2.	2.	3.	3.	3.	3.	3.
5.	16.	95.	464.	1506.	2833.	3481.	3821.	3947.	3912.
3770.	3565.	3346.	3104.	2853.	2603.	2360.	2128.	1910.	1721.
1566.	1419.	1281.	1154.	1036.	928.	829.	766.	717.	670.
625.	582.	541.	502.	465.	430.	398.	367.	339.	312.

STOR

21852.	21853.	21855.	21856.	21856.	21857.	21857.	21857.	21857.	21857.
21863.	21892.	22096.	23051.	24914.	26498.	27234.	27587.	27712.	27678.
27532.	27531.	27081.	26806.	26521.	26236.	25959.	25696.	25448.	25217.
24596.	24791.	24598.	24418.	24252.	24100.	23961.	23831.	23706.	23585.
23468.	23356.	23250.	23149.	23054.	22964.	22879.	22800.	22727.	22658.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3947.	3907.	3601.	2320.	62233.
CMS	112.	111.	102.	66.	1762.
INCHES		1.57	5.78	11.16	12.48
MM		39.79	146.71	283.57	316.90
AC-FT		1937.	7143.	13807.	15430.
THOUS CU M		2390.	8811.	17030.	19032.

MAXIMUM STORAGE = 27712.

STATION 121, PLAN 1, RTIO 4

Sheet 8 of 28

OUTFLOW

TAMS

Job No. ________ Sheet ____ of ____

Project ________ Date ________

Subject ________ By ________

Sheet 9 of 28

0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
3.	8.	48.	232.	599.	1041.	1368.	1557.	1660.	1698.
1629.	1644.	1576.	1492.	1399.	1300.	1200.	1102.	1006.	915.
822.	770.	726.	682.	639.	597.	557.	519.	482.	448.
415.	384.	355.	328.	302.	278.	256.	236.	217.	199.

STOR

21851.	21852.	21852.	21853.	21853.	21853.	21853.	21853.	21853.	21853.
21857.	21871.	21973.	22450.	23401.	24259.	24720.	24986.	25131.	25155.
25171.	25109.	25013.	24895.	24763.	24625.	24484.	24345.	24210.	24081.
23960.	23843.	23728.	23615.	23504.	23396.	23292.	23193.	23098.	23008.
22923.	22843.	22765.	22698.	22632.	22570.	22513.	22460.	22411.	22365.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1698.	1686.	1588.	1104.	30667.
CMS	48.	48.	45.	31.	868.
INCHES		.68	2.55	5.31	6.15
MM		17.17	64.67	134.98	156.16
AC-FT		836.	3149.	6572.	7603.
THOUS CU M		1031.	3884.	8107.	9379.

MAXIMUM STORAGE = 25185.

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SUB-AREA RUNOFF COMPUTATION

5D SWINGING BRIDGE SUB-AREA RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	118.00	0.00	202.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.00	82.00	96.00	107.00	112.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .823

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	2.00	.13	0.00	0.00

GIVEN UNIT GRAPH, NUHGQ= 17

2537.	5327.	4440.	3425.	2664.	1903.	1395.	1015.	761.	533.
381.	304.	254.	203.	127.	101.	0.			

Job No. _____ Project _____ Subject _____

TAMS

UNIT GRAPH TOTALS 25370. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA
STRTQ= -.80 QRCSN= -.46 RTIOR= 3.70

U MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	END-OF-PERIOD FLOW MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	3.00	1	.02	0.00	.02	83.	1.04	6.00	26	0.00	0.00	0.00	13081.
1.01	6.00	2	.02	0.00	.02	73.	1.04	9.00	27	0.00	0.00	0.00	11477.
1.01	9.00	3	.06	0.00	.06	64.	1.04	12.00	28	0.00	0.00	0.00	10069.
1.01	12.00	4	.06	0.00	.06	56.	1.04	15.00	29	0.00	0.00	0.00	8834.
1.01	15.00	5	.23	0.00	.23	49.	1.04	18.00	30	0.00	0.00	0.00	7751.
1.01	18.00	6	.48	0.00	.48	43.	1.04	21.00	31	0.00	0.00	0.00	6800.
1.01	21.00	7	.03	0.00	.03	38.	1.05	0.00	32	0.00	0.00	0.00	5966.
1.02	0.00	8	.03	0.00	.03	33.	1.05	3.00	33	0.00	0.00	0.00	5235.
1.02	3.00	9	.41	0.00	.41	29.	1.05	6.00	34	0.00	0.00	0.00	4593.
1.02	6.00	10	.41	0.00	.41	26.	1.05	9.00	35	0.00	0.00	0.00	4030.
1.02	9.00	11	1.30	.73	.57	1867.	1.05	12.00	36	0.00	0.00	0.00	3535.
1.02	12.00	12	1.30	.91	.39	6195.	1.05	15.00	37	0.00	0.00	0.00	3102.
1.02	15.00	13	5.02	4.63	.39	19813.	1.05	18.00	38	0.00	0.00	0.00	2721.
1.02	18.00	14	10.18	9.79	.39	56016.	1.05	21.00	39	0.00	0.00	0.00	2388.
1.02	21.00	15	.61	.22	.39	78320.	1.06	0.00	40	0.00	0.00	0.00	2095.
1.03	0.00	16	.61	.22	.39	64875.	1.06	3.00	41	0.00	0.00	0.00	1838.
1.03	3.00	17	0.00	0.00	0.00	50776.	1.06	6.00	42	0.00	0.00	0.00	1613.
1.03	6.00	18	0.00	0.00	0.00	38645.	1.06	9.00	43	0.00	0.00	0.00	1415.
1.03	9.00	19	0.00	0.00	0.00	32687.	1.06	12.00	44	0.00	0.00	0.00	1241.
1.03	12.00	20	0.00	0.00	0.00	28679.	1.06	15.00	45	0.00	0.00	0.00	1089.
1.03	15.00	21	0.00	0.00	0.00	25162.	1.06	18.00	46	0.00	0.00	0.00	956.
1.03	18.00	22	0.00	0.00	0.00	22076.	1.06	21.00	47	0.00	0.00	0.00	838.
1.03	21.00	23	0.00	0.00	0.00	19369.	1.07	0.00	48	0.00	0.00	0.00	736.
1.04	0.00	24	0.00	0.00	0.00	16993.	1.07	3.00	49	0.00	0.00	0.00	645.
1.04	3.00	25	0.00	0.00	0.00	14909.	1.07	6.00	50	0.00	0.00	0.00	566.
									SUM	20.76	16.50	4.26	579490.
										(527.)	(419.)	(108.)	(16409.33)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	78320.	69383.	46561.	22970.	579164.
CMS	2218.	1965.	1318.	650.	16400.
INCHES		5.47	14.68	21.73	22.83
MM		138.93	372.93	551.92	579.85
AC-FT		34405.	92352.	136678.	143594.
THOUS CU M		42438.	113914.	168590.	177121.

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 1

83.	73.	64.	56.	49.	43.	38.	33.	29.	26.	
1867.	6195.	19813.	56016.	78320.	64875.	50776.	38645.	32687.	28679.	
25162.	22076.	19369.	16993.	14909.	13081.	11477.	10069.	8834.	7751.	
6800.	5966.	5235.	4593.	4030.	3535.	3102.	2721.	2388.	2095.	
1838.	1613.	1415.	1241.	1089.	956.	838.	736.	645.	566.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	78320.	69383.	46561.	22970.	579164.
CMS	2218.	1965.	1318.	650.	16400.
INCHES		5.47	14.68	21.73	22.83
MM		138.93	372.93	551.92	579.85
AC-FT		34405.	92352.	136678.	143594.

Sheet 10 of 28

Sheet _____ of _____ Date _____ By _____

THOUS CU M 42438. 113914. 168590. 177121.

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 2

62.	54.	46.	42.	37.	32.	28.	25.	22.	19.
1400.	4646.	14260.	42012.	58740.	48656.	38082.	28983.	24515.	21509.
18271.	16557.	14526.	12745.	11182.	9811.	8608.	7552.	6626.	5813.
5106.	4475.	3926.	3445.	3022.	2652.	2326.	2041.	1791.	1571.
1378.	1209.	1061.	931.	817.	717.	629.	552.	484.	425.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	58740.	52037.	34921.	17227.	434373.
CMS	1663.	1474.	989.	488.	12300.
INCHES		4.10	11.01	16.30	17.12
MM		104.20	279.69	413.94	434.89
AC-FT		25804.	69264.	102509.	107696.
THOUS CU M		31828.	85436.	126443.	132841.

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 3

41.	36.	32.	28.	25.	22.	19.	17.	15.	13.
933.	3097.	9907.	28008.	39160.	32438.	25388.	19322.	16344.	14339.
12581.	11038.	9684.	8497.	7455.	6540.	5738.	5035.	4417.	3875.
3400.	2983.	2617.	2296.	2015.	1768.	1551.	1361.	1194.	1047.
919.	806.	707.	621.	545.	478.	419.	368.	323.	283.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	39160.	34692.	23280.	11485.	289582.
CMS	1109.	982.	659.	325.	8200.
INCHES		2.73	7.34	10.86	11.41
MM		69.47	186.46	275.96	289.92
AC-FT		17202.	46176.	68339.	71797.
THOUS CU M		21219.	56957.	84295.	88560.

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 4

21.	18.	16.	14.	12.	11.	9.	8.	7.	6.
467.	1549.	4953.	14004.	19580.	16219.	12694.	9661.	8172.	7170.
6290.	5519.	4842.	4248.	3727.	3270.	2869.	2517.	2209.	1938.
1700.	1492.	1309.	1148.	1007.	884.	775.	680.	597.	524.
459.	403.	354.	310.	272.	239.	210.	184.	161.	142.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19560.	17346.	11640.	5742.	144791.
CMS	554.	491.	330.	163.	4100.
INCHES		1.37	3.67	5.43	5.71
MM		34.73	93.23	137.98	144.96
AC-FT		8601.	23088.	34170.	35899.
THOUS CU M		10609.	28479.	42148.	44280.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

TAMS

Job No. ______ Sheet ______ of ______

Project ______ Date ______

Subject ______ By ______

R23 ROUTE THROUGH SWINGING BRIDGE RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
122	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.000	0.00	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	28060.	0

STORAGE	7620.00	27200.00	37420.00	53670.00
OUTFLOW	457.00	1076.00	38600.00	118900.00

STATION 122, PLAN 1, RTIO 1

OUTFLOW

1637.	1071.	1063.	1055.	1047.	1039.	1031.	1023.	1016.	1008.
1057.	1031.	5610.	25594.	54391.	67464.	60141.	48418.	38729.	33673.
29442.	25801.	22624.	19644.	17409.	15273.	13400.	11757.	10315.	9050.
7946.	6966.	6112.	5362.	4705.	4128.	3622.	3177.	2788.	2446.
2146.	1863.	1652.	1449.	1272.	1116.	1075.	1073.	1069.	1066.

STOR

27353.	27036.	26789.	26541.	26294.	26046.	25800.	25554.	25309.	25065.
25045.	25796.	28271.	33678.	40616.	43261.	41779.	39407.	37446.	36078.
34927.	33934.	33069.	32312.	31648.	31067.	30557.	30109.	29716.	29372.
29069.	28804.	28572.	28367.	28188.	28031.	27893.	27772.	27666.	27573.
27491.	27420.	27357.	27302.	27253.	27211.	27162.	27091.	26996.	26882.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	67464.	62365.	44745.	22619.	581064.
CMS	1910.	1766.	1267.	641.	16454.
INCHES		4.92	14.11	21.40	22.90
MM		124.78	358.39	543.50	581.75
AC-FT		30925.	88751.	134594.	144065.
THOUS CU M		38145.	109473.	166019.	177702.

MAXIMUM STORAGE = 43261.

STATION 122, PLAN 1, RTIO 2

OUTFLOW

1624.	1071.	1063.	1054.	1046.	1039.	1031.	1023.	1015.	1007.
1065.	1020.	2136.	18569.	38474.	50014.	44966.	36689.	30471.	25805.
22252.	19428.	16947.	14894.	13061.	11457.	10051.	8818.	7736.	6787.
5955.	5225.	4586.	4022.	3529.	3096.	2716.	2383.	2091.	1834.
1609.	1412.	1239.	1087.	1074.	1072.	1069.	1065.	1061.	1056.

Sheet 12 of 28

TAMS

Job No. ____ Sheet ____ of ____
Project ____ Date ____
Subject ____ By ____

STOR

27349.	27030.	26779.	26527.	26276.	26026.	25777.	25529.	25282.	25037.
24963.	25462.	27489.	31973.	37386.	39730.	38708.	36900.	35206.	33935.
[illegible]	32198.	31536.	30964.	30464.	30027.	29644.	29309.	29014.	28756.
28529.	28339.	28155.	28002.	27868.	27750.	27647.	27556.	27476.	27407.
27345.	27292.	27244.	27203.	27152.	27076.	26977.	26859.	26724.	26574.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	50014.	45867.	33465.	16890.	437500.
CMS	1416.	1299.	948.	478.	12389.
INCHES		3.62	10.55	15.98	17.24
MM		91.84	268.04	405.84	438.02
AC-FT		22744.	66377.	100504.	108471.
THOUS CU M		28054.	81875.	123969.	133797.

MAXIMUM STORAGE = 39730.

STATION 122, PLAN 1, RTIO 3

OUTFLOW

1611.	1079.	1062.	1054.	1046.	1038.	1030.	1022.	1014.	1006.
1032.	1010.	1053.	10463.	24927.	31728.	29967.	25205.	20593.	17338.
14901.	12967.	11337.	9932.	8708.	7638.	6700.	5878.	5157.	4525.
3970.	3483.	3056.	2681.	2352.	2064.	1811.	1589.	1394.	1223.
1076.	1074.	1072.	1069.	1065.	1060.	1056.	1050.	1045.	1039.

STOR

27346.	27023.	26767.	26512.	26258.	26006.	25754.	25504.	25256.	25039.
24677.	25128.	26484.	29757.	33696.	35548.	35069.	33772.	32516.	31621.
30965.	30439.	29995.	29612.	29279.	28987.	28732.	28508.	28312.	28139.
27986.	27856.	27739.	27637.	27548.	27469.	27400.	27340.	27287.	27240.
27199.	27146.	27068.	26967.	26847.	26710.	26559.	26396.	26222.	26038.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31728.	29588.	22043.	11124.	294855.
CMS	898.	838.	624.	315.	8349.
INCHES		2.33	6.95	10.52	11.62
MM		59.25	176.55	267.29	295.20
AC-FT		14672.	43722.	66192.	73105.
THOUS CU M		18097.	53930.	81646.	90173.

Sheet 13 of 28

TAMS

Job No. ______ Sheet ______ of ______

Project ______ Date ______

Subject ______ By ______

MAXIMUM STORAGE = 35548.

STATION 122, PLAN 1, RTIO 4

OUTFLOW

1598.	1070.	1062.	1054.	1045.	1037.	1029.	1021.	1013.	1005.
999.	999.	1017.	1682.	11135.	15367.	14797.	12533.	10271.	8644.
7447.	6482.	5668.	4966.	4354.	3819.	3350.	2939.	2579.	2262.
1965.	1742.	1528.	1341.	1176.	1075.	1074.	1071.	1067.	1063.
1059.	1054.	1049.	1043.	1037.	1031.	1024.	1018.	1011.	1004.

STOR

27342.	27016.	26756.	26498.	26241.	25985.	25732.	25480.	25230.	24981.
24751.	24793.	25547.	27365.	29940.	31092.	30937.	30320.	29704.	29261.
26935.	28672.	28451.	28259.	28093.	27947.	27819.	27707.	27609.	27523.
27446.	27381.	27323.	27272.	27227.	27183.	27122.	27037.	26930.	26805.
26653.	26508.	26342.	26165.	25979.	25786.	25587.	25382.	25174.	24961.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15367.	14373.	10534.	5341.	154394.
CMS	435.	407.	298.	151.	4372.
INCHES		1.13	3.32	5.05	6.09
MM		28.76	84.37	128.34	154.58
AC-FT		7127.	20894.	31781.	38279.
THOUS CU M		8791.	25773.	39202.	47217.

MAXIMUM STORAGE = 31092.

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COMBINE HYDROGRAPHS

100 COMBINE HYDROGRAPHS 121 & 122

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 1

1432.	1073.	1067.	1059.	1052.	1044.	1037.	1029.	1021.	1013.
1017.	1063.	5200.	26621.	58451.	75299.	69391.	57956.	48023.	42418.
37492.	33083.	29141.	25629.	22512.	19911.	17612.	15555.	13744.	12151.
10751.	9465.	8346.	7350.	6472.	5728.	5066.	4477.	3953.	3489.
3078.	2713.	2417.	2166.	1941.	1739.	1655.	1611.	1569.	1528.

Sheet 14 of 28

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

CFS	75299.	69610.	52360.	27426.	707218.	
CMS	2132.	1971.	1483.	777.	20026.	
INCHES		4.59	13.80	21.68	23.30	
MM		116.48	350.47	550.72	591.72	
AC-FT		34517.	103E55.	163194.	175343.	
THOUS CU M		42577.	128104.	201297.	216283.	

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 2

1625.	1073.	1065.	1058.	1050.	1042.	1035.	1027.	1019.	1011.
1512.	1045.	2279.	19285.	41210.	54889.	51168.	43344.	37102.	32133.
28164.	24753.	21868.	19386.	17162.	15171.	13424.	11876.	10494.	9263.
8169.	7197.	6342.	5614.	4967.	4390.	3878.	3424.	3021.	2664.
2374.	2128.	1908.	1710.	1654.	1611.	1568.	1528.	1489.	1451.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	54889.	50539.	3E756.	20437.	531612.
CMS	1554.	1431.	1097.	579.	15054.
INCHES		3.33	10.21	16.16	17.51
MM		84.57	259.41	410.38	444.79
AC-FT		25U61.	76871.	121607.	131805.
THOUS CU M		30912.	94819.	150000.	162578.

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 3

1612.	1072.	1064.	1056.	1048.	1040.	1032.	1025.	1017.	1009.
1027.	1026.	1148.	10927.	26433.	34562.	33448.	29026.	24540.	21220.
18671.	16532.	14662.	13035.	11561.	10241.	9060.	8006.	7058.	6246.
5536.	4902.	4337.	3835.	3388.	2991.	2640.	2354.	2111.	1893.
1701.	1656.	1613.	1571.	1530.	1491.	1453.	1418.	1384.	1351.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	34562.	32621.	25204.	13423.	357088.
CMS	979.	924.	714.	380.	10112.
INCHES		2.15	6.64	10.61	11.76
MM		54.59	168.70	269.53	298.77
AC-FT		16176.	49991.	79870.	88534.
THOUS CU M		19952.	61663.	98518.	109205.

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 4

1598.	1071.	1063.	1055.	1047.	1038.	1030.	1022.	1014.	1006.
1902.	1007.	1065.	1914.	11736.	16407.	16165.	14090.	11931.	10342.
9135.	8126.	7244.	6458.	5753.	5119.	4551.	4041.	3585.	3177.
2813.	2512.	2254.	2023.	1815.	1673.	1631.	1590.	1550.	1511.
1474.	1438.	1403.	1371.	1339.	1309.	1281.	1254.	1228.	1204.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	16407.	15707.	11961.	6430.	185061.
CMS	465.	445.	339.	182.	5240.
INCHES		1.03	3.15	5.08	6.10
MM		26.28	80.06	129.13	154.84
AC-FT		7788.	23724.	38264.	45883.
THOUS CU M		9607.	29263.	47198.	56596.

Sheet 15 of 28

Job No. _____ Sheet _____ of _____
Project _____
Subject _____ By _____ Date _____

TAMS

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

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SUB-AREA RUNOFF COMPUTATION

51 RIO RESERVOIR SUBAREA INFLOW

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	60.80	0.00	202.00	0.00	0.000	0	1	0

PRECIP DATA

SPFF	PMS	R6	R12	R24	R48	R72	R96
0.00	21.00	88.00	104.00	114.00	120.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .823

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	2.00	.25	0.00	0.00

GIVEN UNIT GRAPH, NUNGG= 13

2676. 3660. 2222. 1438. 1046. 719. 458. 261. 157. 118.
65. 52. 0.

UNIT GRAPH TOTALS 13072. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= -.80 QRCSN= .49 RTIOR= 4.00

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	3.00	1	.02	0.00	.02	42.	1.04	6.00	26	0.00	0.00	0.00	1.
1.01	6.00	2	.02	0.00	.02	37.	1.04	9.00	27	0.00	0.00	0.00	1.
1.01	9.00	3	.08	0.00	.08	32.	1.04	12.00	28	0.00	0.00	0.00	1.
1.01	12.00	4	.08	0.00	.08	28.	1.04	15.00	29	0.00	0.00	0.00	1.
1.01	15.00	5	.29	0.00	.29	24.	1.04	18.00	30	0.00	0.00	0.00	1.
1.01	18.00	6	.59	0.00	.59	21.	1.04	21.00	31	0.00	0.00	0.00	1.
1.01	21.00	7	.03	0.00	.03	18.	1.05	0.00	32	0.00	0.00	0.00	1.
1.02	0.00	8	.03	0.00	.03	16.	1.05	3.00	33	0.00	0.00	0.00	1.
1.02	3.00	9	.37	0.00	.37	14.	1.05	6.00	34	0.00	0.00	0.00	0.
1.02	6.00	10	.37	0.00	.37	12.	1.05	9.00	35	0.00	0.00	0.00	0.
1.02	9.00	11	1.48	.66	.82	1909.	1.05	12.00	36	0.00	0.00	0.00	0.
1.02	12.00	12	1.48	.73	.75	4533.	1.05	15.00	37	0.00	0.00	0.00	0.
1.02	15.00	13	5.38	4.63	.75	17479.	1.05	18.00	38	0.00	0.00	0.00	0.
1.02	18.00	14	10.93	10.18	.75	42809.	1.05	21.00	39	0.00	0.00	0.00	0.
1.02	21.00	15	.56	0.00	.56	49293.	1.06	0.00	40	0.00	0.00	0.00	0.
1.03	0.00	16	.56	0.00	.56	30522.	1.06	3.00	41	0.00	0.00	0.00	0.
1.03	3.00	17	0.00	0.00	0.00	20314.	1.06	6.00	42	0.00	0.00	0.00	0.
1.03	6.00	18	0.00	0.00	0.00	14488.	1.06	9.00	43	0.00	0.00	0.00	0.
1.03	9.00	19	0.00	0.00	0.00	9738.	1.06	12.00	44	0.00	0.00	0.00	0.
1.03	12.00	20	0.00	0.00	0.00	6066.	1.06	15.00	45	0.00	0.00	0.00	0.
1.03	15.00	21	0.00	0.00	0.00	3516.	1.06	18.00	46	0.00	0.00	0.00	0.
1.03	18.00	22	0.00	0.00	0.00	2229.	1.06	21.00	47	0.00	0.00	0.00	0.

Sheet 16 of 28

1.03	21.00	23	0.00	0.00	0.00	1542.	1.07	0.00	48	0.00	0.00	0.00	0.
1.04	0.00	24	0.00	0.00	0.00	904.	1.07	3.00	49	0.00	0.00	0.00	0.
1.04	3.00	25	0.00	0.00	0.00	531.	1.07	6.00	50	0.00	0.00	0.00	0.

SUM 22.24 16.20 6.04 212125.
(565.)(412.)(153.)(6006.71)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	49293.	44479.	24493.	8836.	212107.
CMS	1396.	1260.	694.	250.	6006.
INCHES		6.81	14.99	16.22	16.23
MM		172.85	380.73	412.05	412.14
AC-FT		22056.	48581.	52576.	52588.
THOUS CU M		27205.	59923.	64852.	64867.

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 1

42.	37.	32.	28.	24.	21.	18.	16.	14.	12.
1909.	4533.	17479.	48809.	49293.	30522.	20316.	14488.	9738.	6066.
3516.	2229.	1542.	904.	531.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	49293.	44479.	24493.	8836.	212107.
CMS	1396.	1260.	694.	250.	6006.
INCHES		6.81	14.99	16.22	16.23
MM		172.85	380.73	412.05	412.14
AC-FT		22056.	48581.	52576.	52588.
THOUS CU M		27205.	59923.	64852.	64867.

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 2

32.	29.	24.	21.	18.	16.	14.	12.	10.	9.
1432.	3400.	13109.	36607.	36970.	22891.	15236.	10866.	7303.	4550.
2637.	1672.	1157.	678.	398.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	36970.	33359.	18370.	6627.	159080.
CMS	1047.	945.	520.	188.	4505.
INCHES		5.10	11.26	12.17	12.17
MM		129.66	285.55	309.03	309.11
AC-FT		16562.	36436.	39432.	39441.
THOUS CU M		20404.	44943.	48639.	48650.

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 3

21.	18.	15.	14.	12.	11.	9.	8.	7.	6.
955.	2266.	8739.	24404.	24646.	15261.	10157.	7244.	4869.	3033.
1758.	1114.	771.	452.	265.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24646.	22240.	12246.	4418.	106053.

Sheet 17 of 28

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

CMS	698.	630.	347.	125.	3003.	
INCHES		3.40	7.49	8.11	8.11	
MM		86.43	190.37	206.02	206.07	
AC-FT		11028.	24290.	26788.	26794.	
THOUS CU M		13603.	29962.	32426.	32433.	

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 4

11.	9.	8.	7.	6.	5.	5.	4.	3.	3.
677.	1133.	4370.	12702.	12323.	7630.	5079.	3622.	2434.	1517.
879.	557.	386.	226.	133.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12323.	11120.	6123.	2209.	53027.
CMS	349.	315.	173.	63.	1502.
INCHES		1.70	3.75	4.06	4.06
MM		43.21	95.18	103.01	103.04
AC-FT		5514.	12145.	13144.	13147.
THOUS CU M		6801.	14981.	16213.	16217.

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COMBINE HYDROGRAPHS

101 COMBINE HYDROGRAPH AT 6 WITH RIO INFLOW

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 1

1691.	1110.	1099.	1087.	1076.	1065.	1055.	1045.	1035.	1025.
2927.	5596.	22679.	75430.	107744.	105821.	89706.	72445.	57761.	48485.
41007.	35311.	34683.	26533.	23043.	19912.	17613.	15556.	13745.	12152.
10732.	9468.	8546.	7351.	6472.	5728.	5066.	4477.	3954.	3490.
3078.	2714.	2418.	2166.	1941.	1739.	1655.	1611.	1569.	1528.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	107744.	102273.	73654.	35986.	919325.
CMS	3051.	2896.	2086.	1019.	26032.
INCHES		4.71	13.57	19.89	21.17
MM		119.63	344.61	505.11	537.67
AC-FT		50714.	146061.	214130.	227932.
THOUS CU M		62555.	180201.	264125.	281150.

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 2

1657.	1130.	1089.	1079.	1068.	1058.	1048.	1039.	1029.	1020.
2444.	4444.	15388.	55891.	78180.	77780.	66404.	54210.	44405.	36693.
30605.	26454.	23025.	20064.	17560.	15172.	13425.	11877.	10495.	9284.
8149.	7199.	6342.	5615.	4967.	4391.	3879.	3424.	3021.	2664.

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Job No. _____ Sheet _____ of _____

Project _____ Date _____ By _____

Subject _____

TAMS

TAMS

2375.	2128.	1908.	1710.	1654.	1611.	1568.	1528.	1489.	1451.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	78180.	75036.	54581.	26824.	690692.
CMS	2214.	2125.	1546.	760.	19558.
INCHES		3.46	10.05	14.82	15.90
MM		87.77	255.37	376.52	403.95
AC-FT		37208.	108260.	159617.	171246.
THOUS CU M		45895.	133537.	196884.	211229.

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 3

1633.	1496.	1420.	1070.	1060.	1051.	1042.	1033.	1024.	1015.
1962.	3292.	9889.	35331.	51079.	49823.	43605.	36270.	29409.	24253.
20429.	17647.	15454.	13487.	11876.	10242.	9061.	8007.	7068.	6248.
5536.	4902.	4338.	3835.	3388.	2992.	2640.	2354.	2111.	1894.
1761.	1657.	1613.	1571.	1530.	1491.	1453.	1418.	1384.	1351.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	51079.	48582.	35416.	17678.	463141.
CMS	1446.	1376.	1009.	501.	13115.
INCHES		2.24	6.56	9.77	10.66
MM		56.83	166.64	248.13	270.87
AC-FT		24090.	70643.	105190.	114828.
THOUS CU M		29715.	87137.	129750.	141639.

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 4

1609.	1080.	1071.	1062.	1053.	1044.	1035.	1026.	1018.	1010.
1479.	2140.	5434.	14116.	24057.	24038.	21244.	17712.	14365.	11859.
10014.	8684.	7630.	6684.	5885.	5120.	4551.	4041.	3585.	3177.
2813.	2512.	2254.	2023.	1815.	1673.	1631.	1590.	1550.	1511.
1474.	1438.	1403.	1371.	1339.	1309.	1281.	1254.	1228.	1204.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24057.	23344.	16889.	8566.	238087.
CMS	681.	661.	478.	243.	6742.
INCHES		1.08	3.11	4.73	5.48
MM		27.31	79.02	120.24	139.25
AC-FT		11576.	33499.	50972.	59030.
THOUS CU M		14278.	41321.	62872.	72812.

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HYDROGRAPH ROUTING

10 PIO DAM ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR

Sheet 19 of 28

Subject _____ Project _____ Job No. _____

TAMS

0.0	0.000	0.00	1	1	0	0		0	

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	13110.	-1

STAGE	810.00	815.00	817.00	819.00	823.90	825.00	829.00	830.00	832.00
FLOW	0.00	0.00	2240.00	20636.00	51242.00	62090.00	76045.00	80359.00	91306.00
CAPACITY=	13110.	15105.	15983.	17385.	19413.	22803.			
ELEVATION=	810.	815.	817.	820.	824.	830.			

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
810.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
825.0	2.8	1.5	1000.

STATION 6, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	3.	0.	0.	0.	211.	614.	819.	920.
1422.	4155.	28706.	53136.	105273.	107523.	93716.	76125.	62370.	50369.
44116.	37455.	32470.	28049.	24272.	21035.	17436.	16022.	13745.	12423.
11795.	9642.	8423.	7470.	6543.	5908.	5126.	4537.	4003.	3536.
3117.	2750.	2444.	2226.	2143.	1997.	1853.	1747.	1672.	1613.

STORAGE

13527.	13873.	14147.	14418.	14686.	14951.	15188.	15346.	15426.	15466.
15665.	16031.	16457.	19465.	22535.	22630.	21984.	21068.	20016.	19248.
18664.	18215.	17528.	17119.	16778.	16486.	16369.	16333.	16275.	16242.
16250.	16171.	16143.	16116.	16092.	16074.	16056.	16041.	16028.	16016.
16005.	15996.	15988.	15977.	15965.	15888.	15831.	15790.	15760.	15737.

STAGE

811.0	811.9	812.6	813.3	813.9	814.6	815.2	815.5	815.7	815.8
816.3	817.1	818.0	824.1	829.5	829.7	828.6	826.9	825.1	823.7
822.5	821.2	820.3	819.4	818.7	818.1	817.8	817.7	817.6	817.6
817.5	817.4	817.3	817.3	817.2	817.2	817.2	817.1	817.1	817.1
817.0	817.0	817.0	817.0	816.9	816.8	816.7	816.6	816.5	816.4

PEAK OUTFLOW IS 107523. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	107523.	103384.	73023.	35979.	910409.
CMS	3045.	2927.	2068.	1019.	25780.
INCHES		4.76	13.45	19.88	20.96
MM		120.93	341.66	505.01	532.45
AC-FT		51265.	144840.	214087.	225721.
THOUS CU M		63234.	178657.	264073.	278423.

Sheet 20 of 28

STATION 6, PLAN 1, RATIO 2

By _____ Date _____ Sheet _____ of _____

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	172.	591.	804.	910.
1505.	2561.	14669.	40581.	73029.	79675.	69619.	58111.	46986.	39782.
33029.	26005.	24222.	21120.	17498.	15618.	13427.	12138.	10557.	9432.
8244.	7314.	6411.	5693.	5026.	4450.	3927.	3470.	3059.	2699.
2430.	2215.	2123.	1971.	1832.	1736.	1666.	1609.	1561.	1517.

STORAGE

13521.	13663.	14134.	14403.	14669.	14933.	15172.	15337.	15420.	15462.
15617.	15991.	16501.	19301.	20962.	21266.	20632.	19750.	18946.	18242.
17582.	17114.	16773.	16494.	16371.	16323.	16267.	16234.	16194.	16166.
16136.	16112.	16089.	16071.	16054.	16039.	16026.	16014.	16004.	15995.
15987.	15973.	15936.	15877.	15823.	15786.	15758.	15736.	15717.	15700.

STAGE

811.0	811.9	812.6	813.2	813.9	814.6	815.2	815.5	815.7	815.8
816.2	816.0	817.7	821.8	826.6	827.3	826.2	824.6	823.1	821.7
820.4	819.4	818.7	818.1	817.8	817.7	817.6	817.5	817.5	817.4
817.3	817.3	817.2	817.2	817.2	817.1	817.1	817.1	817.0	817.0
817.0	817.0	816.9	816.8	816.6	816.6	816.5	816.4	816.4	816.4

PEAK OUTFLOW IS 79675. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	79675.	75499.	54303.	26816.	681904.
CMS	2256.	2138.	1538.	759.	19309.
INCHES		3.48	10.00	14.82	15.70
MM		89.31	254.07	376.41	398.81
AC-FT		37438.	107709.	159569.	169067.
THOUS CU M		46179.	132856.	196825.	208541.

STATION 6, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	132.	567.	789.	899.
1182.	1877.	6807.	28369.	45052.	51090.	46196.	39197.	32087.	26038.
21756.	17729.	15772.	13612.	12027.	10379.	9171.	8113.	7157.	6327.
5603.	4968.	4392.	3885.	3432.	3031.	2674.	2380.	2210.	2110.
1960.	1825.	1734.	1665.	1610.	1562.	1519.	1479.	1441.	1406.

STORAGE

13515.	13652.	14121.	14388.	14652.	14914.	15152.	15327.	15414.	15458.
15568.	15941.	16450.	17147.	18757.	19347.	18869.	18185.	17490.	16937.
16551.	16276.	16227.	16272.	16232.	16190.	16159.	16132.	16108.	16087.
16064.	16052.	16038.	16025.	16013.	16003.	15994.	15987.	15971.	15932.
15878.	15823.	15784.	15758.	15736.	15717.	15700.	15685.	15670.	15656.

STAGE

811.0	811.9	812.5	813.2	813.9	814.5	815.1	815.5	815.7	815.8
816.1	816.7	817.4	819.5	822.7	823.9	822.9	821.6	820.2	819.0
818.2	817.8	817.7	817.6	817.5	817.4	817.4	817.3	817.3	817.2
817.2	817.1	817.1	817.1	817.1	817.0	817.0	817.0	817.0	816.9
816.9	816.8	816.5	816.5	816.4	816.4	816.4	816.3	816.3	816.3

Sheet 21 of 28

PEAK OUTFLOW IS 51090. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	51090.	48357.	35558.	17650.	454505.
CMS	1447.	1369.	1007.	500.	12870.
INCHES		2.23	6.55	9.75	10.47
MM		56.56	166.37	247.75	265.82
AC-FT		73979.	70528.	105027.	112687.
THOUS CU M		29577.	86995.	129549.	138998.

STATION 6, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	93.	544.	774.	899.
1069.	1420.	3337.	14023.	21886.	24389.	22364.	18322.	14532.	12175.
10115.	8241.	7706.	6795.	5948.	5209.	4589.	4103.	3622.	3222.
2846.	2542.	2278.	2184.	2057.	1906.	1784.	1701.	1638.	1586.
1541.	1500.	1462.	1426.	1392.	1359.	1328.	1299.	1271.	1245.

STORAGE

13509.	13842.	14109.	14373.	14635.	14895.	15141.	15318.	15438.	15453.
15520.	15662.	16011.	16282.	16563.	16788.	16606.	16392.	16295.	16235.
16193.	16151.	16122.	16099.	16077.	16059.	16043.	16030.	16018.	16008.
15998.	15991.	15984.	15961.	15911.	15852.	15804.	15772.	15747.	15727.
15709.	15695.	15678.	15664.	15651.	15638.	15626.	15614.	15603.	15593.

STAGE

811.0	811.6	812.5	813.2	813.8	814.5	815.1	815.5	815.7	815.8
815.9	816.3	817.1	817.6	818.2	818.7	818.3	817.9	817.7	817.5
817.4	817.4	817.3	817.2	817.2	817.2	817.1	817.1	817.1	817.1
817.0	817.0	817.0	816.9	816.8	816.7	816.6	816.5	816.5	816.4
816.4	816.3	816.3	816.3	816.2	816.2	816.2	816.2	816.1	816.1

PEAK OUTFLOW IS 24389. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24389.	23257.	16902.	8531.	229682.
CMS	691.	659.	479.	242.	6504.
INCHES		1.07	3.11	4.71	5.20
MM		27.20	79.08	119.75	134.33
AC-FT		11532.	33525.	50765.	56946.
THOUS CU M		14225.	41353.	62617.	70242.

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HYDROGRAPH ROUTING

7 CHANNEL ROUTE AT STATION 10+00

Sheet 22 of 28

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____ By _____

TAMS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

GN(1)	GN(2)	GN(3)	ELMXT	FLMAX	RLNTH	SEL
.0350	.0350	.0350	765.0	740.0	1000.	.01750

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 740.00 40.00 720.00 70.00 717.00 80.00 705.00 160.00 705.00
170.00 715.00 220.00 720.00 310.00 740.00

STORAGE	0.00	3.45	7.05	10.79	14.67	18.70	22.98	28.13	34.74	42.52
	50.42	59.63	68.94	78.76	89.08	99.91	111.25	123.09	135.44	148.30
OUTFLOW	0.00	1240.15	3921.41	7687.38	12398.78	17976.94	24592.28	32659.61	42574.20	54742.14
	68937.55	85095.86	103232.27	123378.72	145575.66	169868.18	196304.15	224933.00	255805.15	288971.53
STAGE	705.00	706.94	708.88	710.53	712.37	714.21	716.05	717.89	719.74	721.58
	723.42	725.26	727.11	728.95	730.79	732.63	734.47	736.32	738.16	740.00
FLOW	0.00	1240.15	3921.41	7687.38	12398.78	17976.94	24592.28	32659.61	42574.20	54742.14
	68937.55	85095.86	103232.27	123378.72	145575.66	169868.18	196304.15	224933.00	255805.15	288971.53

STATION 7, PLAN 1, RTIO 1

OUTFLOW

0.	0.	0.	0.	0.	0.	207.	610.	819.	918.
1420.	4117.	20621.	53051.	105128.	107657.	93141.	76472.	62288.	50210.
44007.	37598.	32355.	28186.	24156.	21167.	17325.	16140.	13641.	12533.
10697.	9746.	8328.	7569.	6453.	5903.	5038.	4629.	3917.	3625.
3055.	2834.	2364.	2306.	2065.	2075.	1779.	1821.	1600.	1683.

STOR

0.	0.	0.	0.	0.	0.	1.	2.	2.	3.
4.	7.	20.	41.	70.	71.	64.	55.	47.	40.
36.	31.	28.	25.	23.	21.	18.	17.	16.	15.
13.	12.	11.	11.	10.	9.	8.	8.	7.	7.
6.	6.	5.	5.	5.	5.	4.	4.	4.	4.

STAGE

705.0	705.0	705.0	705.0	705.0	705.0	705.3	705.9	706.2	706.4
707.0	708.8	714.9	721.3	727.3	727.5	726.1	724.3	722.6	720.9
720.6	719.8	717.8	716.9	715.9	715.1	714.0	713.6	712.8	712.4
711.7	711.3	710.8	710.5	709.9	709.7	709.2	709.0	708.7	708.5
707.1	707.9	707.6	707.6	707.4	707.4	707.2	707.2	707.1	707.1

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME

Sheet 23 of 28

TAMS

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

CFS	107657.	103396.	73028.	35978.	910393.
CMS	3049.	2928.	2068.	1019.	25779.
INCHES		4.76	13.45	19.88	20.96
MM		120.94	341.69	505.00	532.44
AC-FT		51271.	144850.	214086.	225717.
THOUS CU M		63241.	178670.	264071.	278418.

MAXIMUM STORAGE = 71.

MAXIMUM STAGE IS 727.5

STATION 7, PLAN 1, RTIO 2

OUTFLOW

0.	0.	0.	0.	0.	0.	168.	585.	804.	907.
1350.	2553.	14688.	40326.	72925.	79749.	69590.	58194.	46960.	39846.
33032.	28058.	24193.	21169.	17470.	15658.	13401.	12172.	10534.	9452.
8423.	7341.	6591.	5718.	5006.	4474.	3907.	3494.	3040.	2722.
2581.	2235.	2101.	1991.	1814.	1755.	1648.	1627.	1543.	1534.

STOR

0.	0.	0.	0.	0.	0.	0.	2.	2.	3.
4.	5.	16.	33.	53.	57.	51.	45.	38.	33.
28.	25.	23.	21.	18.	17.	15.	14.	13.	12.
11.	10.	10.	9.	8.	8.	7.	6.	6.	5.
5.	5.	5.	4.	4.	4.	4.	4.	4.	4.

STAGE

705.0	705.0	705.0	705.0	705.0	705.0	705.2	705.9	706.2	706.3
706.9	707.7	713.1	719.3	723.9	724.7	723.5	722.0	720.4	719.2
718.0	716.8	715.9	715.1	714.0	713.4	712.7	712.3	711.6	711.2
710.7	710.4	709.9	709.6	709.2	709.0	708.7	708.4	708.1	707.9
707.6	707.5	707.4	707.4	707.2	707.2	707.1	707.1	707.1	707.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	79749.	75503.	54307.	26816.	681988.
CMS	2258.	2138.	1538.	759.	19309.
INCHES		3.48	10.00	14.82	15.70
MM		88.32	254.09	376.40	398.80
AC-FT		37440.	107717.	159566.	169063.
THOUS CU M		46181.	132866.	196822.	208536.

MAXIMUM STORAGE = 57.

MAXIMUM STAGE IS 724.7

STATION 7, PLAN 1, RTIO 3

OUTFLOW

0.	0.	0.	0.	0.	0.	130.	560.	790.	895.
1180.	1971.	8755.	28311.	45020.	51090.	46221.	39209.	32113.	26043.
21775.	17733.	15779.	13617.	12031.	10386.	9172.	8119.	7159.	6332.
5604.	4970.	4596.	3889.	3432.	3034.	2674.	2383.	2209.	2112.
1960.	1827.	1733.	1667.	1609.	1563.	1518.	1480.	1440.	1437.

Sheet 24 of 28

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

STOR

0.	0.	0.	0.	0.	0.	0.	2.	2.	2.
3.	4.	12.	25.	36.	40.	37.	32.	28.	24.
21.	19.	17.	16.	14.	13.	12.	11.	10.	9.
9.	8.	8.	7.	6.	6.	5.	5.	5.	5.
4.	4.	4.	4.	4.	4.	4.	4.	4.	4.

STAGE

705.0	705.0	705.0	705.0	705.0	705.0	705.2	705.8	706.2	706.3
716.6	707.3	710.9	716.9	720.1	721.0	720.3	719.1	717.8	716.4
715.3	714.1	713.5	712.8	712.2	711.6	711.1	710.7	710.3	709.9
709.5	709.2	708.9	708.7	708.3	708.1	707.8	707.6	707.5	707.4
707.3	707.2	707.2	707.1	707.1	707.1	707.0	707.0	707.0	707.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	51090.	48355.	35561.	17650.	454491.
CMS	1447.	1369.	1007.	500.	12870.
INCHES		2.23	6.55	9.75	10.46
MM		56.56	166.38	247.74	265.81
AC-FT		23978.	70535.	105026.	112684.
THOUS CU M		29576.	87004.	129547.	138993.

MAXIMUM STORAGE = 40.

MAXIMUM STAGE IS 721.0

STATION 7, PLAN 1, RTIO 4

OUTFLOW

0.	0.	0.	0.	0.	0.	91.	536.	776.	894.
1051.	1413.	3324.	13960.	21906.	24357.	22406.	18301.	14574.	12147.
10151.	8808.	7745.	6763.	5986.	5177.	4625.	4071.	3657.	3192.
2879.	2512.	2310.	2154.	2088.	1878.	1814.	1673.	1666.	1559.
1566.	1474.	1487.	1401.	1416.	1336.	1352.	1276.	1294.	1223.

STOR

0.	0.	0.	0.	0.	0.	0.	1.	2.	2.
3.	4.	6.	16.	21.	23.	22.	19.	16.	14.
13.	12.	11.	10.	9.	8.	8.	7.	7.	6.
6.	5.	5.	5.	5.	4.	4.	4.	4.	4.
4.	4.	4.	4.	4.	4.	4.	4.	4.	3.

STAGE

705.0	705.0	705.0	705.0	705.0	705.0	705.1	705.8	706.2	706.3
716.6	717.0	708.3	712.9	715.3	716.0	715.4	714.3	713.1	712.3
711.5	711.0	710.5	710.1	709.7	709.3	709.0	708.8	708.5	708.2
708.0	707.7	707.6	707.5	707.4	707.3	707.2	707.1	707.1	707.1
707.1	707.0	707.0	707.0	707.0	706.9	706.9	706.9	706.9	706.8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24357.	23257.	16904.	8531.	229669.
CMS	690.	659.	479.	242.	6503.
INCHES		1.07	3.11	4.71	5.29
MM		27.20	79.09	119.75	134.32
AC-FT		11552.	33530.	50764.	56943.
THOUS CU M		14245.	41358.	62617.	70238.

Sheet 25 of 28

TAMS

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____ By _____

MAXIMUM STORAGE = 23.

MAXIMUM STAGE IS 716.0

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .75	RATIO 3 .50	RATIO 4 .25
HYDROGRAPH AT	1	23.20	1	20621.	15466.	10310.	5155.
		(60.09)		(583.92)(	437.94)(	291.96)(	145.98)(
ROUTED TO	121	23.20	1	9539.	6654.	3947.	1698.
		(60.09)		(270.11)(	188.43)(	111.77)(	48.09)(
HYDROGRAPH AT	2	118.00	1	78320.	58740.	39160.	19580.
		(305.62)		(2217.79)(	1663.34)(	1108.89)(	554.45)(
ROUTED TO	122	118.00	1	67464.	50014.	31728.	15367.
		(305.62)		(1910.37)(	1416.24)(	898.44)(	435.13)(
2 COMBINED	3	141.20	1	75299.	54889.	34562.	16407.
		(365.71)		(2132.24)(	1554.27)(	978.68)(	464.60)(
HYDROGRAPH AT	4	60.80	1	49293.	36970.	24646.	12323.
		(157.47)		(1395.82)(	1046.96)(	697.91)(	348.95)(
2 COMBINED	5	202.00	1	107744.	78180.	51079.	24057.
		(523.18)		(3050.97)(	2213.80)(	1446.40)(	681.22)(
ROUTED TO	6	202.00	1	107523.	79675.	51090.	24389.
		(523.18)		(3044.71)(	2256.14)(	1446.70)(	690.63)(
ROUTED TO	7	202.00	1	107657.	79749.	51090.	24357.
		(523.18)		(3048.51)(	2258.24)(	1446.71)(	689.72)(

Sheet 21 of 28

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	810.00	810.00	825.00
STORAGE	13110.	13110.	19978.
OUTFLOW	0.	0.	62090.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	829.69	4.69	22630.	107523.	15.00	48.00	0.00
.75	827.28	2.28	21266.	79675.	9.00	48.00	0.00
.50	823.87	0.00	19347.	51090.	0.00	48.00	0.00
.25	818.72	0.00	16788.	24389.	0.00	48.00	0.00

PLAN 1 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	107657.	727.5	48.00
.75	79749.	724.7	48.00
.50	51090.	721.0	48.00
.25	24357.	716.0	48.00

Sheet 28 of 28

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

CASE B

FLASHBOARD AT EL. 815 AT
BEGINNING OF FLOOD ROUTING
(Sheets 1 of 28 thru 28 of 28)

Job No. _____ Project _____ Suit _____ Sheet _____ of _____ Date _____

TAMS

CASE B
FLASHBOARDS IN PLACE TO EL. 815 AT START OF FLOOD ROUTING.

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  01 APR 80
**********************************
     1          A1                    RIO DAM PHASE 1 SAFETY INVESTIGATION
     2          A2                    HEC 1 DB  PMF ANALYSIS
     3          A3                    JULY 1981
     4          B     50      3       0       0       0       0       0       0       0       0
     5          B1    5
     6          J     1       4       1
     7          J1    .1      0.75    0.5     0.25
     8          K     1                                                       1
     9          K1      49 TORONTO SUB-AREA RUNOFF
    10          M     1       -1      23.2            202                                     1
    11          P             21      102     114     124     134
    12          T                                                       2       .3
    13          U     15
    14          U1    499     1347    848     647     499     349     224     155     120     100
    15          U1    75      50      40      35
    16          X     -.8     -.55    4.3
    17          K     1       121                                               1
    18          K1      R20 ROUTE THROUGH TORONTO RESERVOIR
    19          Y                             1       1
    20          Y1    1                                                                 21850
    21          Y2  21850   23920   25300   27370   28750   32000
    22          Y3    0     800     1780    3600    5000    10000
    23          K     0       2                                               1
    24          K1      50 SWINGING BRIDGE SUB-AREA RUNOFF
    25          M     1       -1      118             202                                     1
    26          P             21      82      96      107     112
    27          T                                                       2       0.13
    28          U     17
    29          U1  2537    5327    4440    3425    2664    1903    1395    1015    761     533
    30          U1  381     304     254     203     127     101
    31          X     -.8     -.46    3.7
    32          K     1       122                                               1
    33          K1      R21 ROUTE THROUGH SWINGING BRIDGE RESERVOIR
    34          Y                             1       1
    35          Y1    1                                                                 28060
    36          Y2  7520    27200   37420   53670
    37          Y3  457     1076    38600   118900
    38          K     2       3                                               1
    39          K1      100 COMBINE HYDROGRAPHS 121 & 122
    40          K     0       4                                               1
    41          K1      51 RIO RESERVOIR SUBAREA INFLOW
    42          M     1       -1      60.8            202                                     1
    43          P             21      88      104     114     120
    44          T                                                       2       .25
    45          U     13
    46          U1  2876    3660    2222    1438    1046    719     458     261     157     118
    47          U1  65      52
    48          X     -.8     .49     4
    49          K     2       5                                               1
    50          K1      101 COMBINE HYDROGRAPH AT 6 WITH RIO INFLOW
```

Sheet 1 of 28

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Sul

TAMS

```
K     1     6                                                  1
K1      10  RIO DAM  ROUTING
Y                                          1     1
Y1    1                                                  15105    -1
Y4   810    815    817    818   823.9    825    829    830    832
Y5     0      0   2240  20636  51242  62090  76045  80359  91304
Y5 13110  15105  15983  17385  19413  22203
YE   810    815    817    820    824    830
YS   810
YD   825    2.8    1.5   1000
K     1     7                                                  1
K1      7 CHANNEL ROUTE AT STATION 10+00
Y                                          1     1
Y1    1
Y6  .035   .035   .035    705    740   1000   .0175
Y7     0    740     40    720     74    717     80    705    160    705
Y7   170    715    220    720    310    740
K    99
```

Sheet 2 of 28

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____

TAMS

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	121
RUNOFF HYDROGRAPH AT	2
ROUTE HYDROGRAPH TO	122
COMBINE 2 HYDROGRAPHS AT	3
RUNOFF HYDROGRAPH AT	4
COMBINE 2 HYDROGRAPHS AT	5
ROUTE HYDROGRAPH TO	6
ROUTE HYDROGRAPH TO	7
END OF NETWORK	

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
SAP SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80
****

RUN DATE= 81/06/20.
TIME= 12.51.22.

RIO DAN PHASE 1 SAFETY INVESTIGATION
HEC 1 DB PMF ANALYSIS
JULY 1981

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
50	3	0	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 .75 .50 .25

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

49 TORONTO SUB-AREA RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	23.20	0.00	202.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.00	102.00	114.00	124.00	134.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .883

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	2.00	.30	0.00	0.00

GIVEN UNIT GRAPH, NUNGQ= 15

499. 1347. 848. 647. 499. 349. 224. 155. 120. 100.
75. 50. 40. 35. 0.

UNIT GRAPH TOTALS 4988. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= -.80 QRCSN= -.55 RTIOR= 4.30

END-OF-PERIOD FLOW

HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

sheet 4 of 28

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____

TAMS

1.01	3.00	1	.03	0.00	.03	16.	1.04	6.00	26	0.00	0.00	0.00	2930.
1.01	6.00	2	.03	0.00	.03	14.	1.04	9.00	27	0.00	0.00	0.00	2533.
1.01	9.00	3	.09	0.00	.09	12.	1.04	12.00	28	0.00	0.00	0.00	2189.
1.01	12.00	4	.09	0.00	.09	10.	1.04	15.00	29	0.00	0.00	0.00	1892.
1.01	15.00	5	.50	0.00	.50	9.	1.04	18.00	30	0.00	0.00	0.00	1635.
1.01	18.00	6	1.02	0.00	1.02	8.	1.04	21.00	31	0.00	0.00	0.00	1413.
1.01	21.00	7	.04	0.00	.04	7.	1.05	0.00	32	0.00	0.00	0.00	1221.
1.02	0.00	8	.04	0.00	.04	6.	1.05	3.00	33	0.00	0.00	0.00	1056.
1.02	3.00	9	.37	0.00	.37	5.	1.05	6.00	34	0.00	0.00	0.00	912.
1.02	6.00	10	.37	0.00	.37	4.	1.05	9.00	35	0.00	0.00	0.00	788.
1.02	9.00	11	1.11	.21	.90	110.	1.05	12.00	36	0.00	0.00	0.00	681.
1.02	12.00	12	1.11	.21	.90	395.	1.05	15.00	37	0.00	0.00	0.00	589.
1.02	15.00	13	6.24	5.34	.90	3132.	1.05	18.00	38	0.00	0.00	0.00	509.
1.02	18.00	14	12.67	11.77	.90	13382.	1.05	21.00	39	0.00	0.00	0.00	440.
1.02	21.00	15	.56	0.00	.56	20621.	1.06	0.00	40	0.00	0.00	0.00	380.
1.03	0.00	16	.56	0.00	.56	13613.	1.06	3.00	41	0.00	0.00	0.00	329.
1.03	3.00	17	0.00	0.00	0.00	10890.	1.06	6.00	42	0.00	0.00	0.00	284.
1.03	6.00	18	0.00	0.00	0.00	9412.	1.06	9.00	43	0.00	0.00	0.00	245.
1.03	9.00	19	0.00	0.00	0.00	8135.	1.06	12.00	44	0.00	0.00	0.00	212.
1.03	12.00	20	0.00	0.00	0.00	7031.	1.06	15.00	45	0.00	0.00	0.00	183.
1.03	15.00	21	0.00	0.00	0.00	6076.	1.06	18.00	46	0.00	0.00	0.00	158.
1.03	18.00	22	0.00	0.00	0.00	5252.	1.06	21.00	47	0.00	0.00	0.00	137.
1.03	21.00	23	0.00	0.00	0.00	4539.	1.07	0.00	48	0.00	0.00	0.00	118.
1.04	0.00	24	0.00	0.00	0.00	3923.	1.07	3.00	49	0.00	0.00	0.00	102.
1.04	3.00	25	0.00	0.00	0.00	3391.	1.07	6.00	50	0.00	0.00	0.00	88.
									SUM	24.84	17.53	7.31	131017.
										(631.)	(445.)	(186.)	(3709.99)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20621.	17059.	10961.	5271.	130966.
CMS	584.	483.	310.	149.	3709.
INCHES		6.84	17.58	25.36	26.26
MM		173.74	446.53	644.19	666.91
AC-FT		8459.	21741.	31365.	32471.
THOUS CU M		10434.	26817.	38688.	40052.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 1

16.	14.	12.	10.	9.	8.	7.	6.	5.	4.
110.	395.	3132.	13382.	20621.	13613.	10890.	9412.	8135.	7031.
6076.	5252.	4539.	3923.	3391.	2930.	2533.	2189.	1892.	1635.
1413.	1221.	1056.	912.	788.	681.	589.	509.	440.	380.
329.	284.	245.	212.	183.	158.	137.	118.	102.	88.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	20621.	17059.	10961.	5271.	130966.
CMS	584.	483.	310.	149.	3709.
INCHES		6.84	17.58	25.36	26.26
MM		173.74	446.53	644.19	666.91
AC-FT		8459.	21741.	31365.	32471.
THOUS CU M		10434.	26817.	38688.	40052.

sheet 5 of 28

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 2

12.	10.	9.	8.	7.	6.	5.	4.	4.	3.
82.	296.	2349.	10036.	15466.	10210.	8168.	7059.	6101.	5273.

TAMS

4557.	5939.	5404.	2942.	2543.	2198.	1899.	1642.	1419.	1226.
1060.	916.	792.	684.	591.	511.	442.	382.	330.	285.
246.	213.	186.	159.	138.	119.	103.	89.	77.	66.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15466.	12794.	8221.	3953.	98225.
CMS	438.	362.	233.	112.	2781.
INCHES		5.13	13.18	19.02	19.69
MM		130.30	334.89	483.14	500.18
AC-FT		6344.	16306.	23523.	24353.
THOUS CU M		7826.	20113.	29016.	30039.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 3

8.	7.	6.	5.	4.	4.	3.	3.	3.	2.
55.	197.	1566.	6691.	10310.	6807.	5445.	4706.	4067.	3515.
3038.	7626.	2269.	1961.	1695.	1465.	1266.	1094.	946.	818.
797.	611.	526.	456.	394.	341.	296.	255.	220.	190.
164.	142.	123.	106.	92.	79.	68.	59.	51.	44.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10310.	8530.	5480.	2635.	65483.
CMS	292.	242.	155.	75.	1854.
INCHES		3.42	8.79	12.68	13.13
MM		86.87	223.26	322.09	333.45
AC-FT		4230.	10870.	15682.	16236.
THOUS CU M		5217.	13408.	19344.	20026.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4

4.	3.	3.	3.	2.	2.	2.	1.	1.	1.
27.	99.	783.	3345.	5155.	3403.	2723.	2353.	2034.	1758.
1519.	1313.	1135.	981.	848.	733.	633.	547.	473.	409.
353.	305.	264.	228.	197.	170.	147.	127.	110.	95.
82.	71.	61.	53.	46.	40.	36.	30.	26.	22.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5155.	4265.	2740.	1318.	32742.
CMS	146.	121.	78.	37.	927.
INCHES		1.71	4.39	6.34	6.56
MM		43.43	111.63	161.05	166.73
AC-FT		2115.	5435.	7841.	8118.
THOUS CU M		2609.	6704.	9672.	10013.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

R2J ROUTE THROUGH TORONTO RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
121	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR

TAMS

Job No. ______ Sheet ____ of ____

Project ______ Date ______

Sul

0.0	0.000	0.00	1	1	0	0		0	
	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT	
	1	0	0	0.000	0.000	0.000	21850.	0	

STORAGE	21850.00	23920.00	25300.00	27370.00	28750.00	32000.00
OUTFLOW	0.00	800.00	1780.00	3600.00	5000.00	10000.00

STATION 121, PLAN 1, RTIO 1

OUTFLOW

1.	3.	4.	4.	5.	5.	5.	5.	5.	5.
10.	32.	190.	1027.	4060.	7835.	9250.	9539.	9294.	8746.
8143.	7261.	6517.	5785.	5103.	4638.	4212.	3798.	3429.	3102.
2791.	2502.	2234.	1989.	1767.	1600.	1444.	1299.	1166.	1043.
932.	831.	765.	717.	669.	624.	580.	539.	499.	463.

STOR

21854.	21857.	21859.	21861.	21862.	21863.	21864.	21864.	21864.	21864.
21976.	21933.	22343.	24239.	27824.	30593.	31513.	31700.	31541.	31185.
30728.	30253.	29736.	29260.	28817.	28393.	27973.	27565.	27175.	26803.
26450.	26121.	25816.	25537.	25282.	25047.	24827.	24623.	24435.	24263.
24106.	23963.	23831.	23704.	23581.	23463.	23351.	23244.	23142.	23047.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	9539.	9405.	8185.	4838.	126154.
CMS	270.	266.	232.	137.	3572.
INCHES		3.77	13.13	23.28	25.29
MM		95.79	333.44	591.31	642.41
AC-FT		4664.	16235.	28790.	31278.
THOUS CU M		5753.	20025.	35512.	38581.

MAXIMUM STORAGE = 31700.

STATION 121, PLAN 1, RTIO 2

OUTFLOW

1.	2.	3.	3.	4.	4.	4.	4.	4.	4.
6.	24.	143.	696.	2736.	4875.	6202.	6654.	6631.	6328.
5876.	5354.	4871.	4492.	4101.	3714.	3373.	3058.	2758.	2476.
2214.	1973.	1758.	1593.	1438.	1295.	1162.	1041.	930.	829.
765.	716.	669.	623.	580.	539.	499.	463.	428.	395.

STOR

21853.	21855.	21857.	21858.	21859.	21860.	21860.	21860.	21860.	21860.
21876.	21912.	22220.	23651.	26387.	28626.	29531.	29825.	29610.	29613.
29319.	28980.	28423.	28249.	27864.	27483.	27112.	26754.	26412.	26091.
25793.	25519.	25269.	25036.	24819.	24616.	24430.	24259.	24103.	23961.
23829.	23703.	23580.	23463.	23350.	23243.	23142.	23047.	22957.	22873.

sheet 7 of 28

TAMS

Job No. ______ Sheet ____ of ____

Project ______ Date ______

Sub ______

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6654.	6561.	5825.	3575.	94112.
CMS	188.	186.	165.	101.	2665.
INCHES		2.63	9.34	17.20	18.87
MM		66.82	237.30	436.91	479.24
AC-FT		3253.	11554.	21272.	23333.
THOUS CU M		4013.	14251.	26239.	28781.

MAXIMUM STORAGE = 29825.

STATION 121, PLAN 1, RTIO 3

OUTFLOW

1.	1.	2.	2.	2.	3.	3.	3.	3.	3.
5.	16.	95.	464.	1506.	2833.	3481.	3821.	3947.	3912.
3770.	[illegible]	3346.	3104.	2853.	2603.	2360.	2128.	1910.	1721.
[illegible]	1419.	[illegible]	1154.	1036.	928.	829.	766.	717.	670.
[illegible]	[illegible]	541.	502.	465.	430.	398.	367.	339.	312.

STOR

[illegible]	21853.	21855.	21856.	21856.	21857.	21857.	21857.	21857.	21857.
[illegible]	[illegible]	[illegible]	23051.	24914.	26498.	27234.	27587.	27712.	27678.
[illegible]	27331.	[illegible]	26806.	26521.	26236.	25959.	25696.	25448.	25217.
[illegible]	[illegible]	24599.	24418.	24252.	24100.	23961.	23831.	23706.	23585.
[illegible]	23356.	23250.	23149.	23054.	22964.	22879.	22800.	22727.	22658.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3947.	3907.	3601.	2320.	62233.
CMS	112.	111.	102.	66.	1762.
INCHES		1.57	5.78	11.16	12.48
MM		39.79	146.71	283.57	316.90
AC-FT		1937.	7143.	13807.	15430.
THOUS CU M		2390.	8811.	17030.	19032.

MAXIMUM STORAGE = 27712.

STATION 121, PLAN 1, RTIO 4

sheet 8 of 28

OUTFLOW

TAMS

Job No. ______
Project ______
Su ______
Sheet ______ of ______
Date ______

0.	1.	1.	1.	1.	1.	1.	1.	1.	1.
3.	9.	45.	232.	599.	1041.	1368.	1557.	1660.	1698.
1669.	1644.	1576.	1492.	1399.	1300.	1200.	1102.	1006.	915.
828.	770.	726.	682.	639.	597.	557.	519.	482.	448.
415.	384.	355.	328.	302.	278.	256.	236.	217.	199.

STOR

21851.	21852.	21852.	21853.	21853.	21853.	21853.	21853.	21853.	21853.
21857.	21871.	21973.	22450.	23401.	24259.	24720.	24986.	25131.	25155.
25171.	25109.	25013.	24895.	24763.	24625.	24484.	24345.	24210.	24081.
23960.	23843.	23728.	23615.	23504.	23396.	23292.	23193.	23098.	23008.
22923.	22843.	22768.	22698.	22632.	22570.	22513.	22460.	22411.	22365.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1698.	1686.	1586.	1104.	30667.
CMS	48.	48.	45.	31.	868.
INCHES		.68	2.55	5.31	6.15
MM		17.17	64.67	134.98	156.16
AC-FT		836.	3149.	6572.	7603.
THOUS CU M		1031.	3884.	8107.	9379.

MAXIMUM STORAGE = 25185.

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SUB-AREA RUNOFF COMPUTATION

50 SWINGING BRIDGE SUB-AREA RUNOFF

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	118.00	0.00	202.00	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.00	82.00	96.00	107.00	112.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .883

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	2.00	.13	0.00	0.00

GIVEN UNIT GRAPH, NUHGQ= 17

2537.	5327.	4440.	3425.	2664.	1903.	1395.	1015.	761.	533.
361.	304.	254.	203.	127.	101.	0.			

sheet 9 of 28

UNIT GRAPH TOTALS 25370. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= -.80 QRCSN= -.46 RTIOR= 3.70

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	3.00	1	.02	0.00	.02	83.	1.04	6.00	26	0.00	0.00	0.00	13081.
1.01	6.00	2	.02	0.00	.02	73.	1.04	9.00	27	0.00	0.00	0.00	11477.
1.01	9.00	3	.06	0.00	.06	64.	1.04	12.00	28	0.00	0.00	0.00	10069.
1.01	12.00	4	.06	0.00	.06	56.	1.04	15.00	29	0.00	0.00	0.00	8834.
1.01	15.00	5	.23	0.00	.23	49.	1.04	18.00	30	0.00	0.00	0.00	7751.
1.01	18.00	6	.49	0.00	.49	43.	1.04	21.00	31	0.00	0.00	0.00	6800.
1.01	21.00	7	.03	0.00	.03	38.	1.05	0.00	32	0.00	0.00	0.00	5966.
1.02	0.00	8	.03	0.00	.03	33.	1.05	3.00	33	0.00	0.00	0.00	5235.
1.02	3.00	9	.41	0.00	.41	29.	1.05	6.00	34	0.00	0.00	0.00	4593.
1.02	6.00	10	.41	0.00	.41	26.	1.05	9.00	35	0.00	0.00	0.00	4030.
1.02	9.00	11	1.30	.73	.57	1867.	1.05	12.00	36	0.00	0.00	0.00	3535.
1.02	12.00	12	1.30	.91	.39	6195.	1.05	15.00	37	0.00	0.00	0.00	3102.
1.02	15.00	13	5.02	4.63	.39	19813.	1.05	18.00	38	0.00	0.00	0.00	2721.
1.02	18.00	14	10.18	9.79	.39	56016.	1.05	21.00	39	0.00	0.00	0.00	2388.
1.02	21.00	15	.61	.22	.39	78320.	1.06	0.00	40	0.00	0.00	0.00	2095.
1.03	0.00	16	.61	.22	.39	64875.	1.06	3.00	41	0.00	0.00	0.00	1839.
1.03	3.00	17	0.00	0.00	0.00	50776.	1.06	6.00	42	0.00	0.00	0.00	1613.
1.03	6.00	18	0.00	0.00	0.00	38645.	1.06	9.00	43	0.00	0.00	0.00	1415.
1.03	9.00	19	0.00	0.00	0.00	32687.	1.06	12.00	44	0.00	0.00	0.00	1241.
1.03	12.00	20	0.00	0.00	0.00	28679.	1.06	15.00	45	0.00	0.00	0.00	1089.
1.03	15.00	21	0.00	0.00	0.00	25162.	1.06	18.00	46	0.00	0.00	0.00	956.
1.03	18.00	22	0.00	0.00	0.00	22076.	1.06	21.00	47	0.00	0.00	0.00	838.
1.03	21.00	23	0.00	0.00	0.00	19369.	1.07	0.00	48	0.00	0.00	0.00	736.
1.04	0.00	24	0.00	0.00	0.00	16993.	1.07	3.00	49	0.00	0.00	0.00	645.
1.04	3.00	25	0.00	0.00	0.00	14909.	1.07	6.00	50	0.00	0.00	0.00	566.
									SUM	20.76	16.50	4.26	579490.
										(527.)	(419.)	(108.)	(16409.33)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	78320.	69383.	46561.	22970.	579164.
CMS	2218.	1965.	1318.	650.	16400.
INCHES		5.47	14.68	21.73	22.83
MM		138.93	372.93	551.92	579.85
AC-FT		34405.	92352.	136678.	143594.
THOUS CU M		42438.	113914.	168590.	177121.

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 1

83.	73.	64.	56.	49.	43.	38.	33.	29.	26.
12867.	6195.	19813.	56016.	78320.	64875.	50776.	38645.	32687.	28679.
25162.	22076.	19369.	16993.	14909.	13081.	11477.	10069.	8834.	7751.
6800.	5966.	5235.	4593.	4030.	3535.	3102.	2721.	2388.	2095.
1839.	1613.	1415.	1241.	1089.	956.	838.	736.	645.	566.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	78320.	69383.	46561.	22970.	579164.
CMS	2218.	1965.	1318.	650.	16400.
INCHES		5.47	14.68	21.73	22.83
MM		138.93	372.93	551.92	579.85
AC-FT		34405.	92352.	136678.	143594.

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Job No. _____ Project _____ Date _____ Sheet _____ of _____

TAMS

TAMS

THOUS CU M			42438.	113914.	168590.	177121.				

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 2

42.	54.	48.	42.	37.	32.	28.	25.	22.	19.	
1430.	4646.	14863.	42012.	58740.	48656.	38082.	28983.	24515.	21509.	
16671.	16557.	14526.	12745.	11182.	9811.	8608.	7552.	6626.	5813.	
5100.	4475.	3926.	3445.	3022.	2652.	2326.	2041.	1791.	1571.	
1378.	1209.	1061.	931.	817.	717.	629.	552.	484.	425.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	58740.	52037.	34921.	17227.	434373.
CMS	1663.	1474.	989.	488.	12300.
INCHES		4.10	11.01	16.30	17.12
MM		104.20	279.69	413.94	434.89
AC-FT		25804.	69264.	102509.	107696.
THOUS CU M		31828.	85436.	126443.	132841.

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 3

41.	36.	32.	28.	25.	22.	19.	17.	15.	13.
933.	3097.	9907.	28008.	39160.	32438.	25388.	19322.	16344.	14339.
12561.	11038.	9684.	8497.	7455.	6540.	5738.	5035.	4417.	3875.
3400.	2983.	2617.	2296.	2015.	1768.	1551.	1361.	1194.	1047.
919.	806.	707.	621.	545.	478.	419.	369.	323.	283.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	39160.	34692.	23280.	11485.	289582.
CMS	1109.	982.	659.	325.	8200.
INCHES		2.73	7.34	10.86	11.41
MM		69.47	186.46	275.96	289.92
AC-FT		17202.	46176.	68339.	71797.
THOUS CU M		21219.	56957.	84295.	88560.

HYDROGRAPH AT STA 2 FOR PLAN 1, RTIO 4

21.	18.	15.	14.	12.	11.	9.	8.	7.	6.
467.	1549.	4953.	14004.	19580.	16219.	12694.	9661.	8172.	7170.
6280.	5519.	4842.	4248.	3727.	3270.	2869.	2517.	2209.	1938.
1700.	1492.	1309.	1148.	1007.	884.	775.	680.	597.	524.
459.	403.	354.	310.	272.	239.	210.	184.	161.	142.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19580.	17346.	11640.	5742.	144791.
CMS	554.	491.	330.	163.	4100.
INCHES		1.37	3.67	5.43	5.71
MM		34.73	93.23	137.98	144.96
AC-FT		8601.	23088.	34170.	35899.
THOUS CU M		10609.	28479.	42148.	44280.

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HYDROGRAPH ROUTING

TAMS

Job No. ______________ Sheet ______ of ______

Project ______________ Date ______________

Subject ______________ By ______________

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              821 ROUTE THROUGH SWINGING BRIDGE RESERVOIR

                         ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                           122       1       0       0       0       0       1       0       0
                                                ROUTING DATA
                 QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                   0.0   0.030    0.00       1       1       0       0               0

                         NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                             1       0       0   0.000   0.000   0.000  28060.       0

 STORAGE     7520.00    27200.00    37420.00    53670.00

 OUTFLOW      457.00     1076.00    38600.00   118900.00

                                   STATION     122, PLAN 1, RTIO 1

                                            OUTFLOW
        1637.     1071.     1063.     1055.     1047.     1039.     1031.     1023.     1016.     1008.
        1067.     1031.     5010.    25594.    54391.    67464.    60141.    48418.    38729.    33673.
       29448.    25601.    22624.    19844.    17409.    15273.    13400.    11757.    10315.     9050.
        7940.     6966.     6112.     5362.     4705.     4128.     3622.     3177.     2788.     2446.
        2146.     1883.     1652.     1449.     1272.     1116.     1075.     1073.     1069.     1066.

                                             STOR
       27323.    27036.    26789.    26541.    26294.    26046.    25800.    25554.    25309.    25065.
       25549.    25796.    26271.    33878.    40616.    43261.    41779.    39407.    37446.    36078.
       34927.    33934.    33069.    32312.    31648.    31067.    30557.    30109.    29716.    29372.
       29069.    28804.    28572.    28367.    28188.    28031.    27893.    27772.    27666.    27573.
       27491.    27420.    27357.    27302.    27253.    27211.    27162.    27091.    26996.    26882.

                                             STAGE
          0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
          0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
          0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
          0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
          0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0

                            PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                  CFS     67464.    62365.    44745.    22619.        581064.
                  CMS      1910.     1766.     1267.      641.         16454.
               INCHES                 4.52     14.11     21.40          22.90
                   MM               124.88    358.39    543.50         581.75
                AC-FT                30925.    88751.   134594.        144065.
          THOUS CU M                 38145.   109473.   166019.        177702.


                                   MAXIMUM STORAGE =     43261.

                                   STATION     122, PLAN 1, RTIO 2

                                            OUTFLOW
        1624.     1071.     1063.     1054.     1046.     1039.     1031.     1023.     1015.     1007.
        1065.     1020.     2136.    18589.    38474.    50014.    44966.    36689.    30471.    25805.
       22292.    19428.    16997.    14894.    13061.    11457.    10051.     8818.     7736.     6787.
        5955.     5225.     4584.     4022.     3529.     3096.     2716.     2383.     2091.     1834.
        1609.     1412.     1239.     1087.     1074.     1072.     1069.     1065.     1061.     1056.
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TAMS

Job No. ______ Sheet ____ of ____

Project ______ Date ______

Subject ______ By ______

STOR

27349.	27030.	26778.	26527.	26276.	26026.	25777.	25529.	25282.	25037.
24943.	25462.	27469.	31970.	37386.	39730.	38708.	36900.	35206.	33935.
32976.	32198.	31536.	30964.	30464.	30027.	29644.	29309.	29014.	28756.
28529.	28330.	28155.	28002.	27868.	27750.	27647.	27556.	27476.	27407.
27345.	27292.	27244.	27203.	27152.	27076.	26977.	26859.	26724.	26574.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	50014.	45867.	33465.	16890.	437500.
CMS	1416.	1299.	948.	478.	12389.
INCHES		3.62	10.55	15.98	17.24
MM		91.84	268.04	405.84	438.02
AC-FT		22744.	66377.	100504.	108471.
THOUS CU M		28054.	81875.	123969.	133797.

MAXIMUM STORAGE = 39730.

STATION 122, PLAN 1, RTIO 3

OUTFLOW

1011.	1077.	1062.	1054.	1046.	1038.	1030.	1022.	1014.	1006.
1[illegible]2.	1010.	1053.	10463.	24927.	31728.	29967.	25205.	20593.	17308.
14901.	12967.	11337.	9932.	8708.	7638.	6700.	5878.	5157.	4525.
3970.	3463.	3056.	2681.	2352.	2064.	1811.	1589.	1394.	1223.
1076.	1074.	1072.	1069.	1065.	1060.	1056.	1050.	1045.	1039.

STOR

27346.	27023.	26767.	26512.	26258.	26006.	25754.	25504.	25256.	25039.
24877.	25122.	26464.	29757.	33696.	35548.	35069.	33772.	32516.	31621.
30565.	30439.	29995.	29612.	29279.	28987.	28732.	28508.	28312.	28139.
27958.	27556.	27739.	27637.	27548.	27469.	27400.	27340.	27287.	27240.
27199.	27144.	27068.	26967.	26867.	26710.	26559.	26396.	26222.	26038.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	31728.	29568.	22043.	11124.	294855.
CMS	898.	838.	624.	315.	8349.
INCHES		2.33	6.95	10.52	11.62
MM		59.25	176.55	267.29	295.20
AC-FT		14672.	43722.	66192.	73105.
THOUS CU M		18097.	53930.	81646.	90173.

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TAMS

Job No. ____________ Sheet ____ of ____

Project ____________ Date ____________

Subject ____________

MAXIMUM STORAGE = 35548.

STATION 122, PLAN 1, RTIO 4

OUTFLOW

[illegible]	1070.	1062.	1054.	1045.	1037.	1029.	1021.	1013.	1005.
[illegible]	999.	1017.	1682.	11135.	15367.	14797.	12533.	10271.	8644.
7447.	6472.	5668.	4966.	4354.	3819.	3350.	2939.	2579.	2262.
[illegible]	1742.	1528.	1341.	1176.	1075.	1074.	1071.	1067.	1063.
1059.	1056.	1049.	1043.	1037.	1031.	1024.	1018.	1011.	1004.

STOR

[illegible]	27016.	26756.	26499.	26241.	25985.	25732.	25480.	25230.	24981.
24751.	24793.	25349.	27365.	29940.	31092.	30937.	30320.	29704.	29261.
[illegible]	26672.	26451.	28257.	28093.	27947.	27819.	27707.	27609.	27523.
[illegible]	27381.	27323.	27272.	27227.	27183.	27122.	27037.	26930.	26805.
[illegible]	26509.	26342.	26165.	25979.	25786.	25587.	25382.	25174.	24961.

STAGE

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	15367.	14373.	10534.	5341.	154394.
CMS	435.	407.	298.	151.	4372.
INCHES		1.13	3.32	5.05	6.09
MM		28.78	84.37	128.34	154.58
AC-FT		7127.	20894.	31781.	38279.
THOUS CU M		8791.	25773.	39202.	47217.

MAXIMUM STORAGE = 31092.

********** ********** ********** ********** **********

COMBINE HYDROGRAPHS

100 COMBINE HYDROGRAPHS 121 & 122

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 1

1632.	1073.	1067.	1059.	1052.	1044.	1037.	1029.	1021.	1013.
1017.	1063.	5200.	26621.	58451.	75299.	69391.	57956.	48023.	42418.
37452.	33683.	79141.	25629.	22512.	19911.	17612.	15555.	13744.	12151.
10731.	9463.	[illegible]	7350.	6472.	5728.	5066.	4477.	3953.	3489.
3078.	2713.	2417.	2166.	1941.	1739.	1655.	1611.	1569.	1528.

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PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

CFS	75299.	69610.	52360.	27426.	707218.
CMS	2132.	1971.	1483.	777.	20026.
INCHES		4.59	13.80	21.68	23.30
MM		116.48	350.47	550.72	591.72
AC-FT		34517.	103855.	163194.	175343.
THOUS CU M		42577.	128104.	201297.	216283.

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 2

1425.	1073.	1065.	1058.	1050.	1042.	1035.	1027.	1019.	1011.
1492.	1045.	2279.	19285.	41210.	54889.	51168.	43344.	37102.	32133.
29168.	24763.	21665.	19346.	17162.	15171.	13424.	11876.	10494.	9263.
8169.	7197.	6342.	5614.	4967.	4390.	3878.	3424.	3021.	2664.
2374.	2128.	1909.	1710.	1654.	1611.	1568.	1528.	1489.	1451.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	54889.	50539.	38756.	20437.	531612.
CMS	1554.	1431.	1097.	579.	15054.
INCHES		3.33	10.21	16.16	17.51
MM		84.57	259.41	410.38	444.79
AC-FT		25061.	76871.	121607.	131805.
THOUS CU M		30912.	94819.	150000.	162578.

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 3

1612.	1072.	1064.	1056.	1048.	1040.	1032.	1025.	1017.	1009.
1907.	1024.	1144.	10927.	26433.	36562.	33448.	29026.	24540.	21220.
18671.	16532.	14682.	13035.	11561.	10241.	9060.	8006.	7068.	6246.
5536.	4902.	4327.	3835.	3388.	2991.	2640.	2354.	2111.	1893.
1701.	1656.	1613.	1571.	1530.	1491.	1453.	1418.	1384.	1351.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	36562.	32621.	25204.	13423.	357088.
CMS	979.	924.	714.	380.	10112.
INCHES		2.15	6.64	10.61	11.76
MM		54.59	168.70	269.53	298.77
AC-FT		16176.	49991.	79870.	88534.
THOUS CU M		19952.	61663.	98518.	109205.

SUM OF 2 HYDROGRAPHS AT 3 PLAN 1 RTIO 4

1572.	1071.	1063.	1055.	1047.	1038.	1030.	1022.	1014.	1006.
1902.	1007.	1065.	1914.	11734.	16407.	16165.	14090.	11931.	10342.
9155.	8126.	7244.	6458.	5753.	5119.	4551.	4041.	3585.	3177.
2813.	2512.	2256.	2023.	1815.	1673.	1631.	1590.	1550.	1511.
1474.	1438.	1403.	1371.	1339.	1309.	1281.	1254.	1228.	1204.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	16407.	15707.	11961.	6430.	185061.
CMS	465.	445.	339.	182.	5240.
INCHES		1.03	3.15	5.08	6.10
MM		26.28	80.06	129.13	154.84
AC-FT		7788.	23724.	38264.	45883.
THOUS CU M		9607.	29263.	47198.	56596.

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Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____ By _____

TAMS

Job No. _____ Sheet _____ of _____
Project _____ Date _____
Subject _____ By _____

TAMS

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

21 RIO RESERVOIR SUBAREA INFLOW

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	-1	50.80	0.00	202.00	0.00	0.000	0	1	0

PRECIP DATA

SPFF	PMS	R6	R12	R24	R48	R72	R96
0.00	21.00	88.00	104.00	114.00	120.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .693

LOSS DATA

LKOPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	2.00	.25	0.00	0.00

GIVEN UNIT GRAPH, NUHGG= 13

2476.	3660.	2222.	1438.	1046.	719.	458.	261.	157.	118.
65.	52.	0.							

UNIT GRAPH TOTALS 13072. CFS OR 1.00 INCHES OVER THE AREA

RECESSION DATA

STRTQ= -.80 QRCSN= .49 RTIOR= 4.00

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	3.00	1	.02	0.00	.02	42.	1.04	6.00	26	0.00	0.00	0.00	1.
1.01	6.00	2	.02	0.00	.02	37.	1.04	9.00	27	0.00	0.00	0.00	1.
1.01	9.00	3	.08	0.00	.08	32.	1.04	12.00	28	0.00	0.00	0.00	1.
1.01	12.00	4	.08	0.00	.08	28.	1.04	15.00	29	0.00	0.00	0.00	1.
1.01	15.00	5	.28	0.00	.28	24.	1.04	18.00	30	0.00	0.00	0.00	1.
1.01	18.00	6	.58	0.00	.58	21.	1.04	21.00	31	0.00	0.00	0.00	1.
1.01	21.00	7	.03	0.00	.03	18.	1.05	0.00	32	0.00	0.00	0.00	1.
1.02	0.00	8	.03	0.00	.03	16.	1.05	3.00	33	0.00	0.00	0.00	1.
1.02	3.00	9	.37	0.00	.37	14.	1.05	6.00	34	0.00	0.00	0.00	0.
1.02	6.00	10	.37	0.00	.37	12.	1.05	9.00	35	0.00	0.00	0.00	0.
1.02	9.00	11	1.48	.66	.82	1909.	1.05	12.00	36	0.00	0.00	0.00	0.
1.02	12.00	12	1.48	.73	.75	4533.	1.05	15.00	37	0.00	0.00	0.00	0.
1.02	15.00	13	5.36	4.63	.75	17479.	1.05	18.00	38	0.00	0.00	0.00	0.
1.02	18.00	14	10.93	10.18	.75	44809.	1.05	21.00	39	0.00	0.00	0.00	0.
1.02	21.00	15	.56	0.00	.56	49293.	1.06	0.00	40	0.00	0.00	0.00	0.
1.03	0.00	16	.56	0.00	.56	30522.	1.06	3.00	41	0.00	0.00	0.00	0.
1.03	3.00	17	0.00	0.00	0.00	20314.	1.06	6.00	42	0.00	0.00	0.00	0.
1.03	6.00	18	0.00	0.00	0.00	14488.	1.06	9.00	43	0.00	0.00	0.00	0.
1.03	9.00	19	0.00	0.00	0.00	9738.	1.06	12.00	44	0.00	0.00	0.00	0.
1.03	12.00	20	0.00	0.00	0.00	6066.	1.06	15.00	45	0.00	0.00	0.00	0.
1.03	15.00	21	0.00	0.00	0.00	3516.	1.06	18.00	46	0.00	0.00	0.00	0.
1.03	18.00	22	0.00	0.00	0.00	2229.	1.06	21.00	47	0.00	0.00	0.00	0.

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1.03	21.00	23	0.00	0.00	0.00	1542.	1.07	0.00	48	0.00	0.00	0.00	0.
1.04	0.00	24	0.00	3.00	0.00	904.	1.07	3.00	49	0.00	0.00	0.00	0.
1.04	3.00	25	0.00	0.00	0.00	531.	1.07	6.00	50	0.00	0.00	0.00	0.

SUM 22.24 16.20 6.04 212125.
(565.)(412.)(153.)(6006.71)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	49293.	44479.	24493.	8336.	212107.
CMS	1396.	1260.	694.	250.	6006.
INCHES		6.81	14.99	16.22	16.23
MM		172.85	380.73	412.05	412.14
AC-FT		22056.	48581.	52576.	52588.
THOUS CU M		27205.	59923.	64852.	64867.

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 1

42.	37.	32.	28.	24.	21.	18.	16.	14.	12.
1909.	4533.	17479.	48809.	49293.	30522.	20314.	14488.	9738.	6066.
3516.	2229.	1542.	904.	531.	1.	1.	1.	1.	1.
1.	1.	1.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	49293.	44479.	24493.	8836.	212107.
CMS	1396.	1260.	694.	250.	6006.
INCHES		6.81	14.99	16.22	16.23
MM		172.85	380.73	412.05	412.14
AC-FT		22056.	48581.	52576.	52588.
THOUS CU M		27205.	59923.	64852.	64867.

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 2

32.	28.	24.	21.	18.	16.	14.	12.	10.	9.
1432.	3600.	13109.	36607.	36970.	22891.	15236.	10866.	7303.	4550.
2637.	1672.	1157.	678.	398.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	36970.	33359.	18370.	6627.	159080.
CMS	1047.	945.	520.	188.	4505.
INCHES		5.10	11.24	12.17	12.17
MM		129.64	285.55	309.03	309.11
AC-FT		16542.	36436.	39432.	39441.
THOUS CU M		20404.	44943.	48639.	48650.

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 3

21.	18.	16.	14.	12.	11.	9.	8.	7.	6.
955.	2266.	8739.	24404.	24646.	15261.	10157.	7244.	4869.	3033.
1756.	1114.	771.	452.	265.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24646.	22240.	12246.	4418.	106053.

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Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

CMS	698.	630.	347.	125.	3003.	
INCHES		3.40	7.49	8.11	8.11	
MM		86.43	190.37	206.02	206.07	
AC-FT		11028.	24290.	26288.	26294.	
THOUS CU M		13603.	29962.	32426.	32433.	

HYDROGRAPH AT STA 4 FOR PLAN 1, RTIO 6

11.	9.	8.	7.	6.	5.	5.	4.	3.	3.
477.	1133.	4370.	12202.	12323.	7630.	5079.	3622.	2434.	1517.
879.	557.	396.	226.	133.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12323.	11120.	6123.	2209.	53027.
CMS	349.	315.	173.	63.	1502.
INCHES		1.70	3.75	4.06	4.06
MM		43.21	95.18	103.01	103.04
AC-FT		5514.	12145.	13144.	13147.
THOUS CU M		6801.	14981.	16213.	16217.

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COMBINE HYDROGRAPHS

101 COMBINE HYDROGRAPH AT 6 WITH RIO INFLOW

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	1	0	0

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 1

1681.	1110.	1099.	1087.	1076.	1065.	1055.	1045.	1035.	1025.
2927.	5596.	22679.	75430.	107744.	105821.	89706.	72445.	57751.	48495.
41[illegible].	55511.	30683.	26533.	23043.	19912.	17613.	15556.	13745.	12152.
10732.	9468.	8346.	7351.	6472.	5728.	5066.	4477.	3954.	3490.
3078.	2714.	2415.	2166.	1941.	1739.	1655.	1611.	1569.	1528.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	107744.	102273.	73654.	35986.	919325.
CMS	3051.	2896.	2086.	1019.	26032.
INCHES		4.71	13.57	19.89	21.17
MM		119.63	344.61	505.11	537.67
AC-FT		50714.	146091.	214130.	227932.
THOUS CU M		62555.	180201.	264125.	281150.

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 2

1657.	1100.	1089.	1079.	1068.	1058.	1048.	1039.	1029.	1020.
2446.	4444.	15348.	55891.	78180.	77780.	66404.	54210.	44405.	36693.
29805.	20454.	23025.	20064.	17560.	15172.	13425.	11877.	10495.	9264.
6169.	7198.	6562.	5615.	4967.	4391.	3879.	3424.	3021.	2664.

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Job No. _____ Sheet _____ of _____

Project _____

Subject _____ By _____ Date _____

TAMS

TAMS

2375.	2128.	1908.	1710.	1654.	1611.	1568.	1528.	1489.	1451.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	78180.	75036.	54581.	26824.	690692.
CMS	2214.	2125.	1546.	760.	19558.
INCHES		3.46	10.05	14.82	15.90
MM		87.77	255.37	376.52	403.95
AC-FT		37208.	108260.	159617.	171246.
THOUS CU M		45895.	133537.	196884.	211229.

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 3

1633.	1699.	1090.	1070.	1060.	1051.	1042.	1033.	1024.	1015.
1962.	3292.	9858.	35331.	51079.	49823.	43605.	36270.	29409.	24253.
20429.	17647.	15454.	13487.	11826.	10242.	9061.	8007.	7068.	6246.
5536.	4902.	4538.	3835.	3388.	2992.	2640.	2354.	2111.	1894.
1701.	1657.	1613.	1571.	1530.	1491.	1453.	1418.	1384.	1351.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	51079.	48582.	35616.	17678.	463141.
CMS	1446.	1376.	1009.	501.	13115.
INCHES		2.24	6.56	9.77	10.66
MM		56.83	166.64	248.13	270.87
AC-FT		24090.	70643.	105190.	114828.
THOUS CU M		29715.	87137.	129750.	141639.

SUM OF 2 HYDROGRAPHS AT 5 PLAN 1 RTIO 4

1649.	1080.	1071.	1062.	1053.	1044.	1035.	1026.	1018.	1010.
1479.	2140.	5436.	14116.	24057.	24038.	21244.	17712.	14365.	11859.
19014.	6664.	7633.	6684.	5895.	5120.	4551.	4041.	3585.	3177.
2213.	2512.	2254.	2023.	1815.	1673.	1631.	1590.	1550.	1511.
1474.	1438.	1403.	1371.	1339.	1309.	1281.	1254.	1228.	1204.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24057.	23344.	16889.	8566.	238087.
CMS	681.	661.	478.	243.	6742.
INCHES		1.08	3.11	4.73	5.48
MM		27.31	79.02	120.24	139.25
AC-FT		11576.	33499.	50972.	59030.
THOUS CU M		14278.	41321.	62872.	72812.

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HYDROGRAPH ROUTING

10 RID DAM ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	1	0	0	0	0	1	0	0

ROUTING DATA

LSTR	IPMP	IOPT	ISAME	IRES	AVG	CLOSS	SLOSS

	0.0	0.000	0.00	1	1	0	0	0	

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	15105.	-1

STAGE	810.00	815.00	817.00	818.00	823.90	825.00	829.00	830.00	832.00
FLOW	0.00	0.00	2240.00	20636.00	51242.00	62090.00	76045.00	80359.00	91304.30
CAPACITY=	13110.	15105.	15983.	17385.	19413.	22803.			
ELEVATION=	810.	815.	817.	820.	824.	830.			

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
810.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
825.0	2.8	1.5	1000.

STATION 6, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

958.	1090.	1097.	1095.	1089.	1080.	1071.	1061.	1051.	1041.
3479.	4259.	26654.	53145.	105269.	107525.	93215.	76326.	62370.	50069.
44114.	37455.	32473.	28049.	24272.	21035.	17436.	16022.	13745.	12423.
10795.	9642.	8423.	7470.	6543.	5808.	5126.	4537.	4003.	3536.
3117.	2753.	2444.	2226.	2143.	1997.	1853.	1747.	1672.	1613.

STORAGE

15422.	15532.	15535.	15534.	15532.	15528.	15525.	15521.	15517.	15513.
15659.	16034.	16452.	19466.	22535.	22631.	21984.	21068.	20016.	19248.
18666.	18015.	17528.	17118.	16778.	16486.	16369.	16333.	16275.	16242.
16200.	16171.	16143.	16116.	16092.	16074.	16056.	16041.	16028.	16016.
16005.	15996.	15988.	15977.	15945.	15888.	15831.	15790.	15760.	15737.

STAGE

815.7	816.0	816.0	816.0	816.0	816.0	816.0	815.9	815.9	815.9
816.3	817.1	819.0	824.1	829.5	829.7	828.6	826.9	825.1	823.7
822.5	821.2	820.3	819.4	818.7	818.1	817.8	817.7	817.6	817.6
817.5	817.4	817.3	817.3	817.2	817.2	817.2	817.1	817.1	817.1
817.0	817.0	817.0	817.0	816.9	816.8	816.7	816.6	816.5	816.4

PEAK OUTFLOW IS 107525. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	107525.	103383.	73024.	35979.	918052.
CMS	3045.	2927.	2068.	1019.	25996.
INCHES		4.76	13.45	19.88	21.14
MM		120.93	341.66	505.02	536.92
AC-FT		51264.	144840.	214090.	227616.
THOUS CU M		63234.	178658.	264076.	280760.

STATION 6, PLAN 1, RATIO 2

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Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

796.	1076.	1085.	1085.	1079.	1072.	1063.	1054.	1044.	1035.
1370.	2678.	14692.	40415.	73024.	79676.	69619.	58111.	46986.	39782.
33029.	28005.	24222.	21120.	17498.	15618.	13427.	12138.	10557.	9432.
8244.	7314.	6411.	5693.	5026.	4450.	3927.	3470.	3059.	2699.
2400.	2213.	2120.	1971.	1832.	1736.	1666.	1609.	1561.	1517.

STORAGE

15417.	15527.	15533.	15530.	15528.	15525.	15522.	15518.	15514.	15511.
15642.	15694.	16299.	18304.	20862.	21266.	20632.	19750.	18946.	18242.
17562.	17114.	16773.	16494.	16371.	16323.	16267.	16234.	16194.	16166.
16136.	16112.	16089.	16071.	16054.	16039.	16026.	16014.	16004.	15995.
15987.	15973.	15936.	15877.	15823.	15786.	15758.	15736.	15717.	15700.

STAGE

815.7	816.0	816.0	816.0	816.0	816.0	815.9	815.9	815.9	815.9
816.2	817.0	817.7	821.8	826.6	827.3	826.2	824.6	823.1	821.7
820.6	819.4	819.7	818.1	817.8	817.7	817.6	817.5	817.5	817.4
817.3	817.3	817.2	817.2	817.2	817.1	817.1	817.1	817.0	817.0
817.0	817.0	816.9	816.8	816.6	816.6	816.5	816.4	816.4	816.4

PEAK OUTFLOW IS 79676. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	79676.	75499.	54305.	26817.	689552.
CMS	2256.	2138.	1538.	759.	19526.
INCHES		3.48	10.00	14.82	15.88
MM		88.31	254.08	376.41	403.28
AC-FT		37437.	107712.	159572.	170963.
THOUS CU M		46178.	132861.	196929.	210880.

STATION 6, PLAN 1, RATIO 3

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

785.	1062.	1073.	1074.	1070.	1063.	1055.	1046.	1038.	1029.
1250.	1911.	8671.	28339.	45056.	51089.	46196.	39197.	32087.	26038.
21756.	17729.	15772.	13612.	12027.	10379.	9171.	8113.	7157.	6327.
5603.	4966.	4392.	3885.	3432.	3031.	2674.	2380.	2210.	2110.
1960.	1825.	1734.	1665.	1610.	1562.	1519.	1479.	1441.	1406.

STORAGE

15413.	15521.	15526.	15526.	15524.	15522.	15519.	15515.	15512.	15508.
15595.	15654.	16151.	17144.	18758.	19347.	18869.	18185.	17490.	16937.
16551.	16378.	16327.	16272.	16232.	16190.	16159.	16132.	16108.	16087.
16068.	16052.	16038.	16025.	16013.	16003.	15994.	15987.	15971.	15932.
15873.	15820.	15784.	15756.	15736.	15717.	15700.	15685.	15670.	15656.

STAGE

815.7	815.9	816.0	816.0	816.0	815.9	815.9	815.9	815.9	815.9
816.1	816.7	817.4	819.5	822.7	823.9	822.9	821.6	820.2	819.0
818.2	817.8	817.7	817.6	817.5	817.4	817.4	817.3	817.3	817.2
817.2	817.1	817.1	817.1	817.1	817.0	817.0	817.0	817.0	816.9
816.7	816.6	816.5	816.5	816.4	816.4	816.4	816.3	816.3	816.3

PEAK OUTFLOW IS 51089. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	51089.	48358.	35557.	17653.	462160.
CMS	1447.	1369.	1007.	500.	13087.
INCHES		2.23	6.55	9.76	10.64
MM		56.56	166.36	247.78	270.29
AC-FT		23979.	70526.	105041.	114585.
THOUS CU M		29578.	86992.	129566.	141339.

STATION 6, PLAN 1, RATIO 4

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

773.	1048.	1061.	1064.	1060.	1055.	1047.	1039.	1031.	1023.
1129.	1456.	3402.	13980.	21906.	24386.	22364.	18322.	14532.	12175.
10119.	8441.	7706.	6795.	5948.	5209.	4589.	4103.	3622.	3222.
2846.	2542.	2278.	2184.	2057.	1906.	1784.	1701.	1638.	1586.
1541.	1500.	1462.	1426.	1392.	1359.	1328.	1299.	1271.	1245.

STORAGE

15499.	15516.	15521.	15522.	15521.	15518.	15515.	15512.	15509.	15506.
15548.	15676.	16013.	16281.	16565.	16788.	16606.	16392.	16295.	16235.
16183.	16151.	16122.	16099.	16077.	16059.	16043.	16030.	16018.	16038.
15998.	15991.	15984.	15961.	15911.	15852.	15804.	15772.	15747.	15727.
15709.	15693.	15678.	15664.	15651.	15638.	15626.	15614.	15603.	15593.

STAGE

815.7	815.9	815.9	815.9	815.9	815.9	815.9	815.9	815.9	815.9
816.0	816.3	817.1	817.6	818.2	818.7	818.3	817.9	817.7	817.5
817.4	817.4	817.3	817.2	817.2	817.2	817.1	817.1	817.1	817.1
817.0	817.0	817.0	816.9	816.8	816.7	816.6	816.5	816.5	816.4
816.4	816.3	816.3	816.3	816.2	816.2	816.2	816.2	816.1	816.1

PEAK OUTFLOW IS 24386. AT TIME 48.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	24386.	23261.	16902.	8534.	237342.
CMS	691.	659.	479.	242.	6721.
INCHES		1.07	3.11	4.72	5.46
MM		27.21	79.08	119.78	138.81
AC-FT		11534.	33524.	50779.	58845.
THOUS CU M		14227.	41352.	62635.	72584.

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HYDROGRAPH ROUTING

7 CHANNEL ROUTE AT STATION 10+00

sheet 22 of 28

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

TAMS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

GN(1)	GN(2)	GN(3)	ELNVT	ELMAX	RLNTH	SEL
.0350	.0350	.0350	705.0	740.0	1000.	.01750

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 740.00 40.00 720.00 70.00 717.00 80.00 705.00 160.00 705.00
170.00 715.00 220.00 720.00 310.00 740.00

STORAGE	0.00	3.45	7.05	10.79	14.67	18.70	22.99	28.13	34.74	42.52
	56.82	59.63	68.94	78.76	89.08	99.91	111.25	123.09	135.44	148.30
OUTFLOW	0.00	1240.15	3921.41	7687.38	12398.78	17976.94	24592.28	32659.61	42574.20	54742.10
	68937.55	85095.86	103232.27	123878.72	145575.66	169868.18	196304.15	224933.00	255805.15	288971.53
STAGE	705.00	706.94	708.68	710.53	712.37	714.21	716.05	717.89	719.74	721.58
	723.42	725.26	727.11	728.95	730.79	732.63	734.47	736.32	738.16	740.00
FLOW	0.00	1240.15	3921.41	7687.38	12398.78	17976.94	24592.28	32659.61	42574.20	54742.10
	68937.55	85095.86	103232.27	123878.72	145575.66	169868.18	196304.15	224933.00	255805.15	288971.53

STATION 7, PLAN 1, RTIO 1

OUTFLOW

1524.	338.	1823.	395.	1764.	428.	1699.	455.	1635.	478.
2667.	3695.	21696.	52538.	105642.	107146.	93649.	75967.	62788.	49715.
44497.	37113.	32835.	27711.	24626.	20701.	17785.	15685.	14091.	12088.
11136.	9213.	8755.	7149.	6866.	5496.	5439.	6234.	4305.	3244.
3408.	2470.	2721.	1957.	2407.	1740.	2106.	1501.	1914.	1376.

STOR

4.	1.	4.	1.	4.	1.	4.	1.	4.	1.
5.	7.	21.	41.	70.	71.	64.	55.	47.	39.
30.	31.	26.	25.	23.	20.	19.	17.	16.	14.
14.	12.	12.	10.	10.	9.	9.	7.	7.	6.
6.	5.	5.	4.	5.	4.	5.	4.	4.	4.

STAGE

707.1	705.5	707.2	705.6	707.2	705.6	707.2	705.7	707.1	705.7
707.4	715.5	715.1	721.2	727.3	727.5	726.1	724.2	722.6	723.8
720.0	715.7	717.9	716.8	716.1	715.0	714.1	713.5	712.9	712.2
711.9	711.2	710.9	710.3	710.1	709.5	709.4	708.8	708.9	708.2
707.5	707.7	707.9	707.3	707.6	707.2	707.4	707.0	707.3	706.9

PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME

TAMS

Job No. _____ Project _____ Subject _____ By _____ Date _____ Sheet _____ of _____

CFS	107146.	103396.	73029.	35979.	918053.	
CMS	3034.	2928.	2068.	1019.	25996.	
INCHES		4.76	13.45	19.88	21.14	
MM		120.94	341.69	505.01	536.92	
AC-FT		51271.	144850.	214088.	227616.	
THOUS CU M		63241.	178670.	264074.	280761.	

MAXIMUM STORAGE = 71.

MAXIMUM STAGE IS 727.5

STATION 7, PLAN 1, RTIO 2

OUTFLOW

1561.	335.	1800.	395.	1744.	430.	1681.	457.	1619.	481.
1595.	2146.	15128.	39849.	73427.	79248.	70087.	57701.	47448.	39362.
33481.	27585.	24658.	20706.	17928.	15205.	13849.	11730.	10971.	9031.
6648.	6923.	6703.	5313.	5405.	4081.	4293.	3115.	3411.	2359.
2737.	1888.	2441.	1658.	2140.	1436.	1960.	1322.	1842.	1242.

STOR

4.	1.	4.	1.	4.	1.	4.	1.	4.	1.
4.	5.	17.	33.	53.	56.	51.	44.	38.	33.
29.	25.	23.	20.	19.	17.	16.	14.	13.	12.
12.	10.	10.	8.	9.	7.	7.	6.	6.	5.
5.	4.	5.	4.	5.	4.	4.	4.	4.	3.

STAGE

707.1	705.5	707.2	705.6	707.2	705.6	707.1	705.7	707.1	705.7
707.3	707.5	713.3	719.2	723.9	724.6	723.6	722.0	720.5	719.1
718.0	716.7	716.1	715.0	714.2	713.3	712.8	712.1	711.8	711.1
710.9	710.2	710.1	709.4	709.4	708.8	708.9	708.1	708.3	707.6
707.9	707.3	707.7	707.1	707.5	707.0	707.3	706.9	707.3	706.8

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	79248.	75503.	54309.	26816.	689554.
CMS	2244.	2138.	1538.	759.	19526.
INCHES		3.48	10.00	14.82	15.88
MM		88.32	254.10	376.41	403.29
AC-FT		37439.	107720.	159569.	170964.
THOUS CU M		46161.	132871.	196825.	210881.

MAXIMUM STORAGE = 56.

MAXIMUM STAGE IS 724.6

STATION 7, PLAN 1, RTIO 3

OUTFLOW

1556.	332.	1777.	395.	1725.	432.	1664.	460.	1603.	485.
1771.	1594.	9320.	27786.	45515.	50604.	46702.	38733.	32584.	25577.
22654.	17277.	16233.	13172.	12471.	9951.	9601.	7696.	7576.	5922.
6648.	4573.	4783.	3505.	3508.	2667.	3034.	2031.	2553.	1775.
2269.	1504.	2049.	1358.	1912.	1268.	1808.	1197.	1717.	1138.

sheet 24 of 28

Job No. _____ Sheet _____ of _____
Project _____ Date _____
Subject _____

TAMS

TAMS

STOR

4.	1.	4.	1.	4.	1.	4.	1.	4.	1.
4.	4.	12.	25.	37.	40.	37.	32.	28.	24.
21.	18.	17.	15.	15.	13.	12.	11.	11.	9.
9.	8.	8.	6.	7.	5.	6.	5.	5.	4.
5.	4.	5.	4.	4.	3.	4.	3.	4.	3.

STAGE

707.0	705.5	707.2	705.6	707.2	705.6	707.1	705.7	707.1	705.7
707.2	706.9	711.2	716.8	720.2	721.0	720.4	719.0	717.9	716.3
715.4	714.0	713.6	712.6	712.4	711.4	711.3	710.5	710.5	709.7
709.7	709.0	709.1	708.4	708.6	707.8	708.1	707.4	707.7	707.2
707.6	707.0	707.4	706.9	707.3	706.9	707.2	706.8	707.2	706.7

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	50604.	48356.	35560.	17652.	462162.
CMS	1433.	1369.	1007.	500.	13087.
INCHES		2.23	6.55	9.75	10.64
MM		56.56	166.38	247.78	270.30
AC-FT		23978.	70532.	105039.	114586.
THOUS CU M		29577.	87000.	129564.	141339.

MAXIMUM STORAGE = 40.

MAXIMUM STAGE IS 721.0

STATION 7, PLAN 1, RTIO 4

OUTFLOW

1516.	329.	1754.	395.	1705.	433.	1646.	463.	1587.	498.
1643.	553.	3270.	13444.	22393.	23892.	22864.	17848.	15022.	11705.
10597.	8372.	6173.	6345.	6398.	4772.	5024.	3680.	4042.	2815.
2668.	2152.	2063.	1808.	2425.	1547.	2137.	1356.	1975.	1256.
1664.	1185.	1770.	1126.	1684.	1075.	1605.	1031.	1531.	993.

STOR

4.	1.	4.	1.	4.	1.	4.	1.	4.	1.
4.	3.	7.	15.	22.	23.	22.	19.	17.	14.
13.	11.	11.	9.	10.	9.	8.	7.	7.	6.
6.	5.	5.	4.	5.	4.	5.	4.	4.	3.
4.	3.	4.	3.	4.	3.	4.	3.	4.	3.

STAGE

707.0	705.5	707.2	705.6	707.2	705.6	707.1	705.7	707.1	705.7
707.1	705.4	709.6	712.7	715.4	715.9	715.6	714.2	713.2	712.1
711.7	710.8	710.7	709.9	709.9	709.1	709.2	708.5	708.7	707.9
709.2	707.5	707.8	707.2	707.7	707.1	707.5	706.9	707.3	706.9
707.3	706.8	707.2	706.7	707.1	706.6	707.1	706.5	707.0	706.5

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	23922.	23260.	16904.	8533.	237347.
CMS	677.	659.	479.	242.	6721.
INCHES		1.07	3.11	4.72	5.47
MM		27.21	79.09	119.78	138.81
AC-FT		11534.	33528.	50778.	58846.
THOUS CU M		14227.	41357.	62633.	72586.

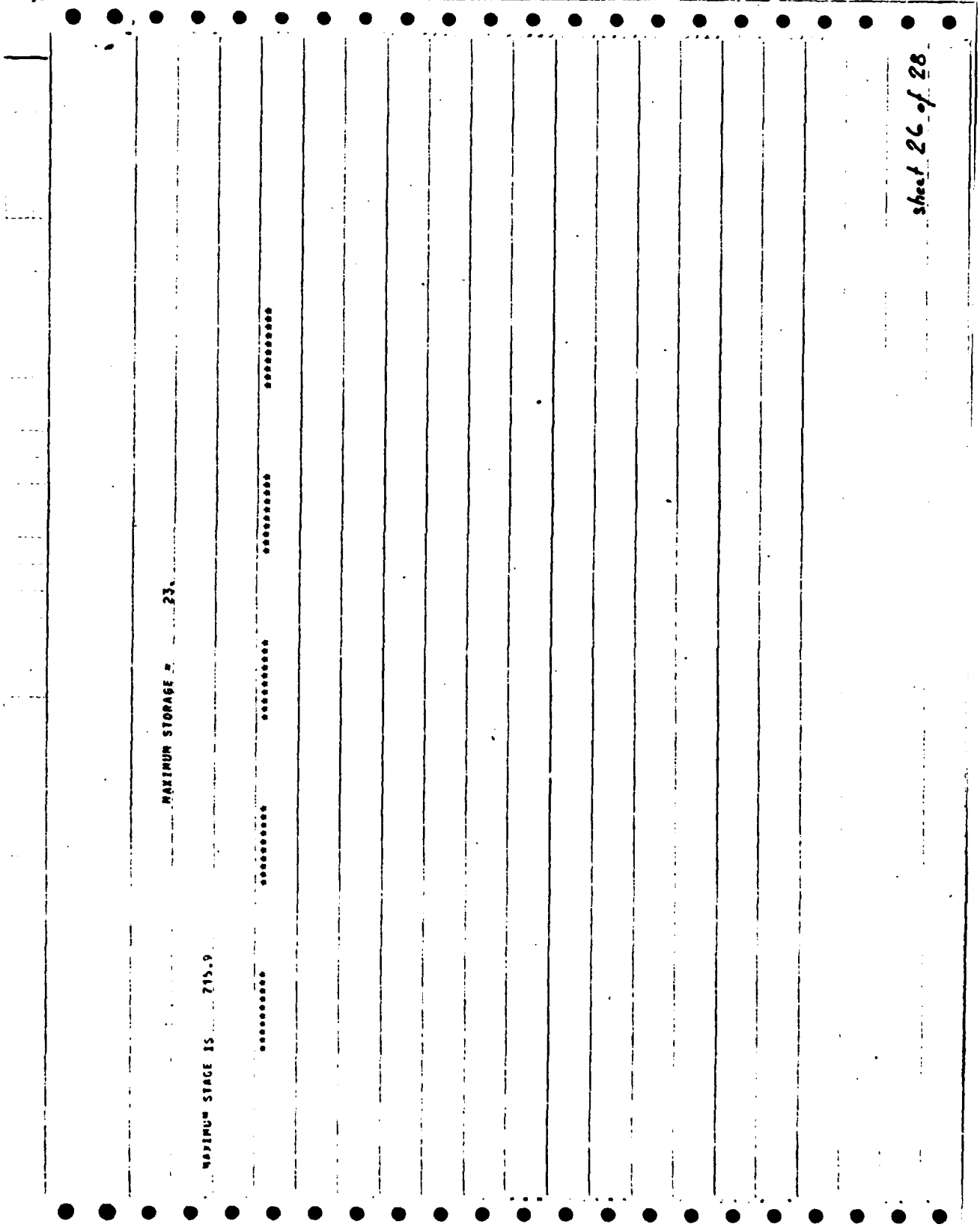
sheet 25 of 28

TAMS

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____ By _____



PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .75	RATIO 3 .50	RATIO 4 .25
HYDROGRAPH AT	1	23.20	1	20621.	15466.	10310.	5155.
		(60.09)		(583.92)(	437.94)(	291.96)(	145.98)(
ROUTED TO	121	23.20	1	9539.	6654.	3947.	1698.
		(60.09)		(270.11)(	188.43)(	111.77)(	48.09)(
HYDROGRAPH AT	2	118.00	1	78320.	58740.	39160.	19580.
		(305.62)		(2217.79)(	1663.34)(	1108.89)(	554.45)(
ROUTED TO	122	118.00	1	67464.	50014.	31728.	15367.
		(305.62)		(1910.37)(	1416.24)(	898.44)(	435.13)(
2 COMBINED	3	141.20	1	75299.	54889.	34562.	16407.
		(365.71)		(2132.24)(	1554.27)(	978.68)(	464.60)(
HYDROGRAPH AT	4	60.20	1	49293.	36970.	24646.	12323.
		(157.47)		(1395.82)(	1046.86)(	697.91)(	348.95)(
2 COMBINED	5	202.00	1	107744.	78180.	51079.	24057.
		(523.18)		(3050.97)(	2213.80)(	1446.40)(	681.22)(
ROUTED TO	6	202.00	1	107525.	79676.	51089.	24386.
		(523.18)		(3044.76)(	2256.18)(	1446.69)(	690.54)(
ROUTED TO	7	202.00	1	107146.	79248.	50604.	23892.
		(523.18)		(3034.03)(	2244.06)(	1432.94)(	676.54)(

Job No. _____ Sheet _____ of _____
Project _____
Subject _____ By _____ Date _____
TAMS

Job No. _____ Sheet _____ of _____

Project _____ Date _____

Subject _____ By _____

TAMS

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	815.00	810.00	825.00
STORAGE	15105.	13110.	19978.
OUTFLOW	0.	0.	62090.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	829.69	4.69	22631.	107525.	15.00	48.00	0.00
.75	827.28	2.28	21266.	79676.	9.00	48.00	0.00
.50	823.97	0.00	19347.	51089.	0.00	48.00	0.00
.25	818.72	0.00	16788.	24386.	0.00	48.00	0.00

PLAN 1 STATION 7

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
1.00	107146.	727.5	48.00
.75	79248.	724.6	48.00
.50	50604.	721.0	48.00
.25	23892.	715.9	48.00

sheet 28 of 28

STRUCTURAL STABILITY ANALYSIS

APPENDIX E

TAMS

Job No. 579-19 Sheet 1 of 19

Project NYS Dam Inspection Date 7-30-81

Subject Rio Dam Stability Analysis By JW

Ch'k. by

Assumptions:

1) Unit Wt of Concrete is 145 pcf

2) Ice load of 5000 lb/ft² acts at normal Pool Level crest of Dam (COE Criteria) Ice is 1ft thick

3) Dam is founded on Rock - $\phi = 45°$ $C = 4500$ psf

4) Dam Site is in Seismic Zone I-

5) Normal operating level of Lake is 810.5'

6) No back fill and minimal silt on upstream side of Dam

7) In assumed failure mode Dam forms a crack at Point A assuming a new point of base Rotation see sheet 3 of 19.

8) Reduced hydrostatic uplift associated with partial drain is calculated as per COE criteria EM 1110-2-2200

9) Simplified Geometry as shown on sheet 3 of 19.

10) Roadway Piers + Roadway Apply a Resultant point load of 8.5 kips/ft acting at a point 9.65' downstream of the upstream spillway face

Additional Data:

1) Based on Backwater flood routing analysis the following maximum headwater and tailwater conditions have been calculated

Case	Headwater El.	Tailwater El.
½ PMF	823.87	746.0
PMF	829.69	746.5

TAMS

Job No. 1579-19 Sheet 2 of 19

Project NYS Dam Inspection Date 7-30-81

Subject Rio Dam - Stability Analyses By JWJ

Ch'k. by

Cases Evaluated

Case I Normal Loading; Lake Level at El. 810.5 - No Ice Load

Case II Case I Condition with the addition of Assumed Ice Loading - 1ft. thickness

Case III Unusual Loading; Lake Level at ½ PMF Stage

Case IV Extreme Loading; Lake Level at PMF Stage

Stability Criteria

a) Overturning - Resultant force shall be contained within the middle ⅓ of the base width for Cases I - II.

b) Sliding - Factor of Safety against sliding failure shall be 3.0 or greater for Cases I - III

Sign Convention

Force ↓ + ↑ − → + ← −

Moment + ↺ ↻ −

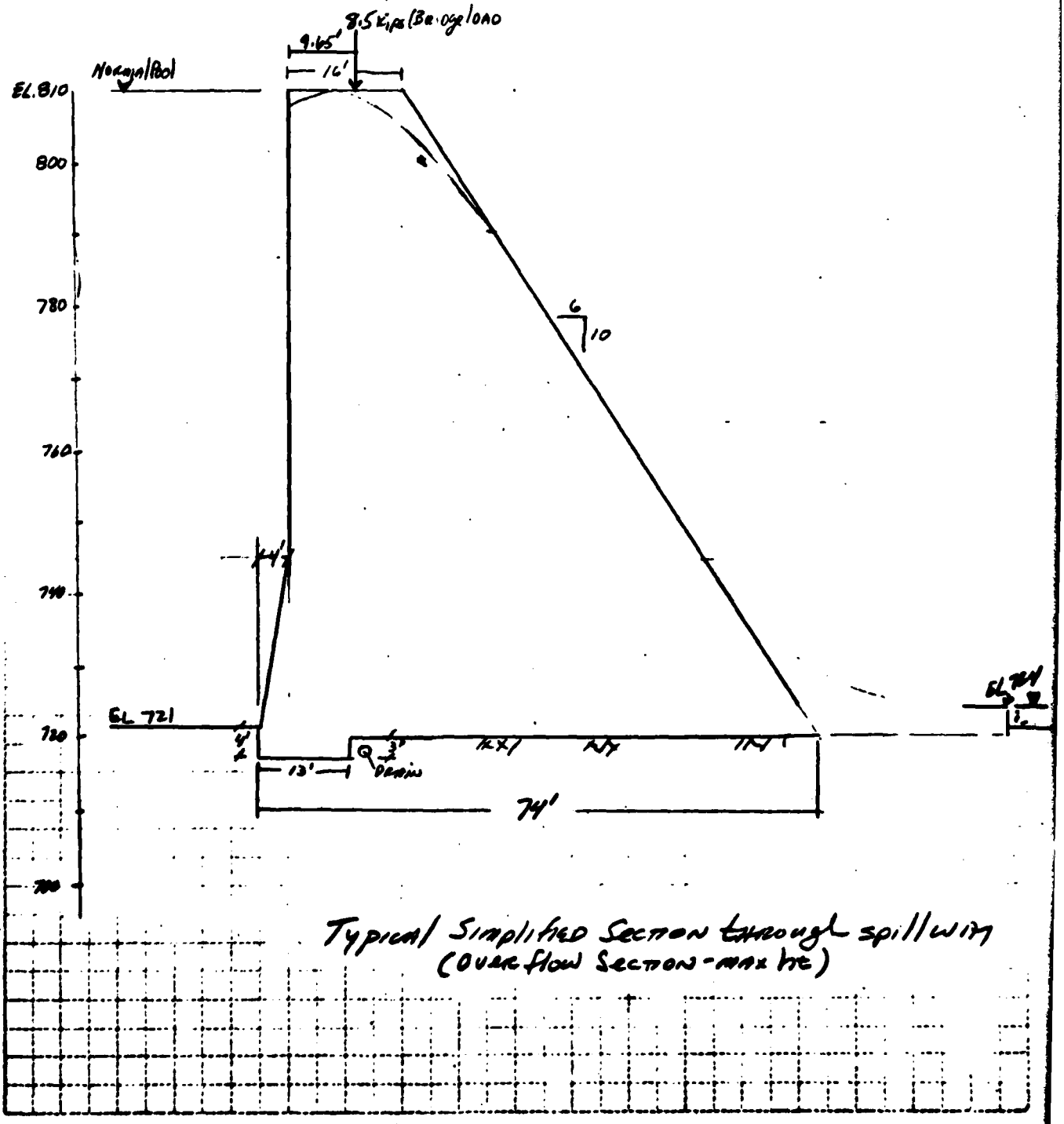
TAMS

Job No. 1529-19 Sheet 3 of 19

Project NYS Dam Inspection Date 7-31-81

Subject RIS Dam Oak Hollows By JW

Ch'k. by



Typical Simplified Section through spillway (Overflow Section - max ht)

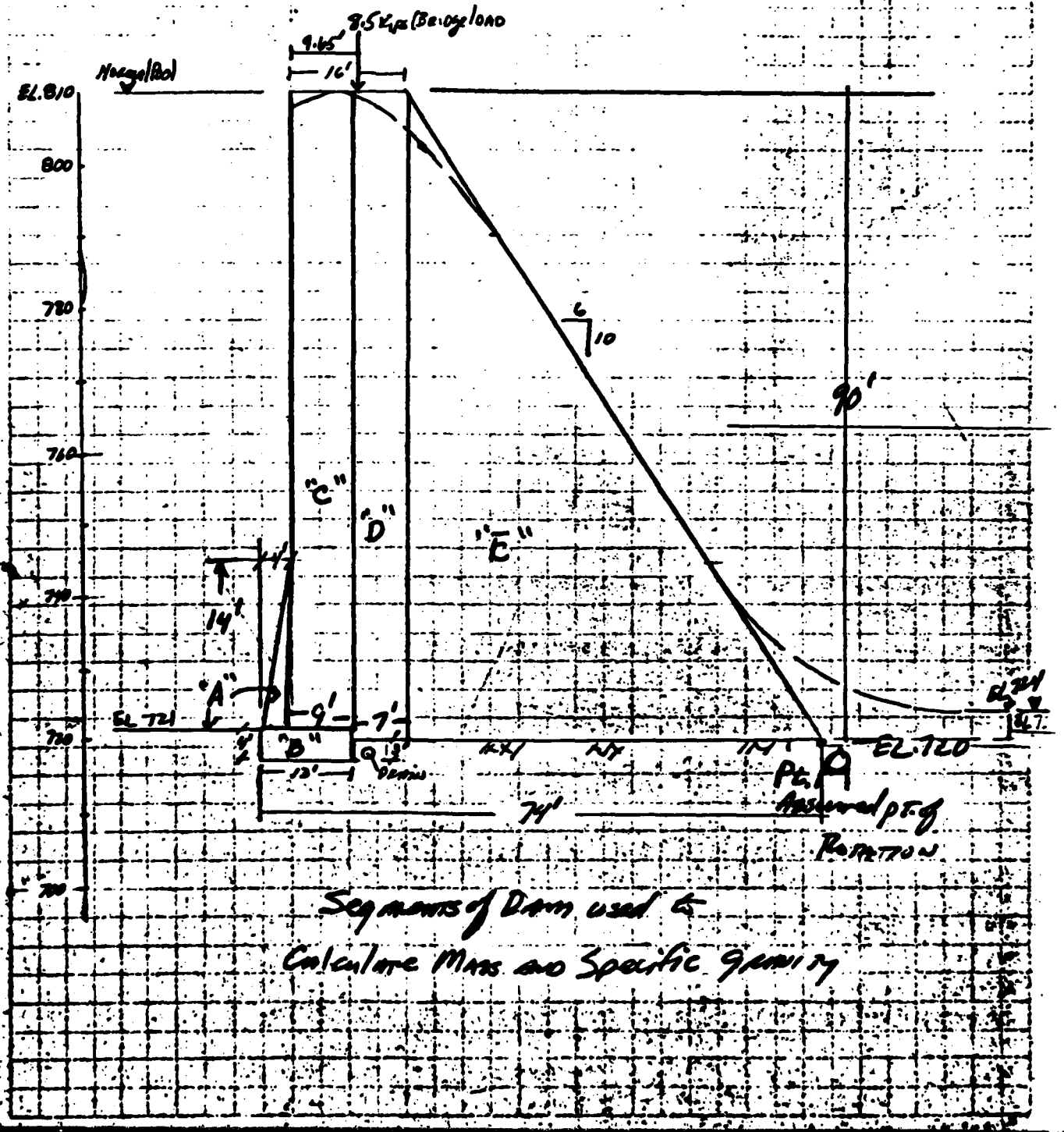
TAMS

Job No. 1579-19 Sheet 4 of 19

Project NYS Dam Inspection Date 7-31-81

Subject RTE DAM Oak Hollows By JW

Ch'k. by



TAMS

Job No. 1579-19 Sheet 5 of 17
Project NYS Dam Inspection Date 7-31-81
Subject Rio Dam - Stability Analysis By DW
Ch'k. by

Calculation of Mass - Concrete @ 145 pcf
(per unit width basis)

Section "A"
$14 \times 4 \times \frac{1}{2} \times 145 = 4.06$ kips $M_{A_x} = 74 - \frac{2}{3} \times 4 = 71.33'$

Section "B" $4 \times 13 \times 145 = 7.54$ kips $M_{A_x} = 74 - 1\frac{1}{2} = 67.50'$

Section "C" $9 \times 89 \times 145 = 116.15$ kips $M_{A_x} = 74 - 4 - \frac{9}{2} = 65.5'$

Section "D" $7 \times 90 \times 145 = 91.35$ kips $M_{A_x} = 74 - 13 - \frac{7}{2} = 57.5'$

Section "E" $\frac{1}{2} \times 90 \times (74-20) \times 145 = 352.35$ kips $M_{A_x} = \frac{2}{3}(74-20) = 36'$

Resultant Reaction from Bridge Deck + Pier as per Dwg. KK 3-50
R = 8.5 kips $M_{A_x} = 74 - 4 - 9.65 = 60.35'$

$\Sigma F_y = 579.95$ kips

$\Sigma M_A = 4.06 \times 71.33 + 7.54 \times 67.5 + 116.15 \times 65.5 + 91.35 \times 57.5 + 352.35 \times 36 + 8.5 \times 60.35 = 26,857$ k ft

x Location of Resultant $\frac{26,857}{579.95} = 46.31'$

Total length of Spillway including Abutment walls is ~487'
for a maximum 90' section $\frac{487}{90} > 4$ ∴ neglect end shear

TAMS

Job No. 1579-19 Sheet 6 of 10
Project NYS Dam Inspection Date 7-31-81
Subject Rio Dam - Stability Analysis By JW
Ch'k. by

Calculate Case I Hydrostatic Forces
Static Pool at 810.5'

Headwater
Top of Spillway EL. 810.0
$.5 \times 62.4 = 31.2$ psf

At base of Dam
$(810.5 - 717) 62.4 = 5834.4$ psf

Total force on Upstream Side $\frac{31.2 + 5834.4}{2} \times \frac{93}{1000} = 272.75$ Kips

Calculate Moment Arm.

$$\frac{272750}{2} \text{ lb} - 31.2\bar{x} - \tfrac{1}{2} 62.4 \bar{x}^2 = 0$$

$$x^2 + x - 4371 = 0$$

$x = 65.6$ $M_{A_y} = 34.4$

$\Sigma F_x = -272.75$ Kips

$\Sigma M_A = -6655.1$ k-ft

Tailwater
$F_x = \frac{1}{2} 4^2 \times 62.4 = 499.2$ lbs $M_{A_x} = 4/3 = 1.33'$
$F_y = \frac{1}{2} 2.4 \times 249.5 = 299.4$ lbs $M_A = 2.4/3 = 0.8'$

Uplift assuming 50% Drain Efficiency Reduction see sheet 7
As shown on sheet 7

$F_A = \frac{5834.4 + 2551}{2} \times 13 = 54.5$ kips

Find $\bar{x} = \frac{13}{3}\left(\frac{2(2551) + 5834.4}{2551 + 5834.4}\right) = 5.65$

$M_A = 74 - \bar{x} = 68.35'$

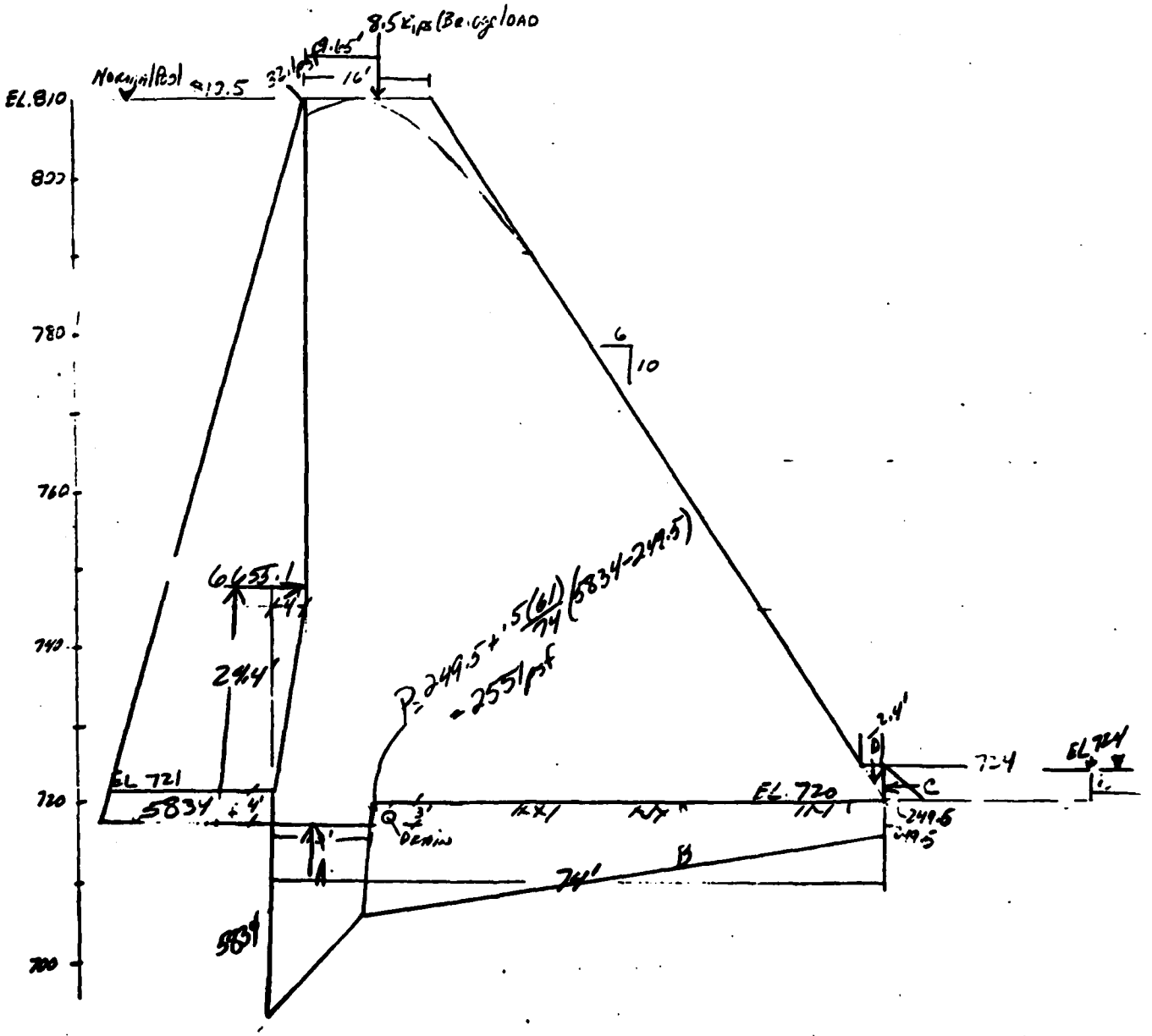
TAMS

Job No. 1579-19 Sheet 7 of 19

Project NYS Dam Inspection Date 7-31-81

Subject RIO DAM OUR Utilities By JW

Ch'k. by



TAMS

Job No. 1579-19 Sheet 8 of 19
Project N45 Dam Inspection Date 2-21-81
Subject R10 Dam - Stability Analysis By JW
Ch'k. by

Cont Uplift cont.

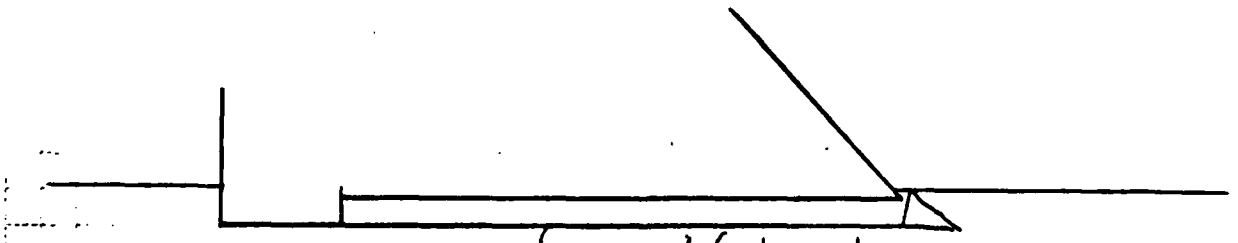
$$F_B = \frac{2551+249.5}{2}\cdot(74-13) = -85.41 \text{ kips}$$

$$\bar{x} = \frac{61}{3}\left(\frac{2\times249.5+2551}{249.5+2551}\right) = 22.1'$$

$\bar{x} = 22.1$ $M_A = 74-13-22.1 = 38.8'$

$\Sigma F_V = -139.61$ $\Sigma M_A = -13693.1$
$\Sigma F_H = -272.2$ kips

For Sliding Failure Assume rock mass fails along plane parallel to base at toe of key (El 717) w/ Passive Resistance from abutment at toe being based on $\phi = 45°$ $c = 1$ ksf



γ_{sat} for Rock = 82.6 pcf

$\phi = 45$ $c = 45$ ksf

$P_{pat\ toe} = \frac{1}{2}(4)^2(82.6)(K_p) + 2c\tan(45+\phi/2)$

$K_p = \tan^2(45+\phi/2) = 5.82$

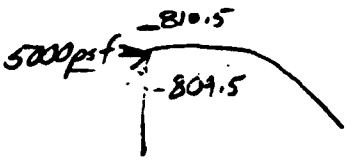
$= 3851 + 2(4500)(2.41)$
$= 3851 + 21690$
$= 25.54$ kips

Additional Mass of Rock to be included w/ Mass of Dam to Assess sliding $3\times(74-13)\times 82.6 = 15.11$ kips

TAMS

Job No. 1579-19 Sheet 9 of 19
Project NYS Dam Inspection Date 7-31-81
Subject Rio Dam - Stability Analysis By JEJ
Ch'k. by

Case II ICE loading



Ice 1 foot thick exerting a force based on 5000 p.f

$F_x = 5.0$ Kips

$M_{A_A} = 810 - 720 = 90$

$M_A = 5.0 \times 90$
$= 450$ k ft

Case III 1/2 PMF

Headwater @ 823.87

see sheet 10 for Pressure Diagram

H_2O Pressure at top of Spillway, El 810

$(823.87 - 810.) 62.4 = 0.865$ ksf

Pressure at Heel of Dam El 717

$(823.87 - 717) 62.4 = 6.668$ ksf

Total Pressure on Upstream Face of Dam

$\frac{0.865 + 6.668}{2} \times 93 = 310.13$ kips

find $\bar{x}$:

$\bar{x} = \frac{93}{3}\left(\frac{2(.865) + 6.668}{.865 + 6.668}\right) = 34.56$

$M_A = 34.56 - 3 = 31.56$

TAMS

Job No. 1579-19 Sheet 10 of 19
Project NYS Dam Inspection Date 7-31-81
Subject Rio Dam - Stability Analysis By JCL
Ch'k. by

Case III cont.

INITIAL RESERVOIR POOL ELEV. 724 - 17.5 = 706.5

Tailwater Conditions
Flood level @ EL 740.0
to account for hydrodynamic forces use 60% of F_H & F_V calculated by Westergaard's parabolic water pressure theory

$P_H = (740 - 720) 62.4 = 1248$ psf

$F_H = \frac{1}{2} 1248.0 \times 20 = +12.480$ x .6 = 7.49 kips

$M_A = 20/3 = 6.67'$

$P_V = 1248$ psf

$F_V = \frac{1}{2}(1248 \times 12.36) = +7.713$ kips $\quad M_A = \frac{12.36}{3} = 4.12'$

$\times 1.60$

$+ 4.63$ kips

Uplift assuming drain at 50% effectiveness

$H_{at\ drain} = H_1 + \frac{K_x}{L}(H_2 - H_1)$

$= 1248 + \frac{.50 \times 61}{74}(6668 - 1248)$

$= 3482$ psf

Pt 1: At heel (ref. Sheet 11)

$F_{H_1} = \frac{6668 + 3482}{2} \times 13 = 65.975$ kips

find $\bar{X}$: $\bar{X} = \frac{13}{3}\left(\frac{3482 + 2 \times 6668}{3482 + 6668}\right) = 5.82'$

$M_A = 74 - 5.82 = 68.2'$

Pt 2 downstream of Drain

$F_{H_2} = \frac{1248 + 3482}{2} \times 61 = 144.26$ kips

find $\bar{X}$ for toe: $\bar{X} = \frac{61}{3}\left(\frac{2 \times 1248 + 3482}{1248 + 3482}\right) = 25.7$

$M_A = 74 - 13 - \bar{X} = 35.2'$

TAMS

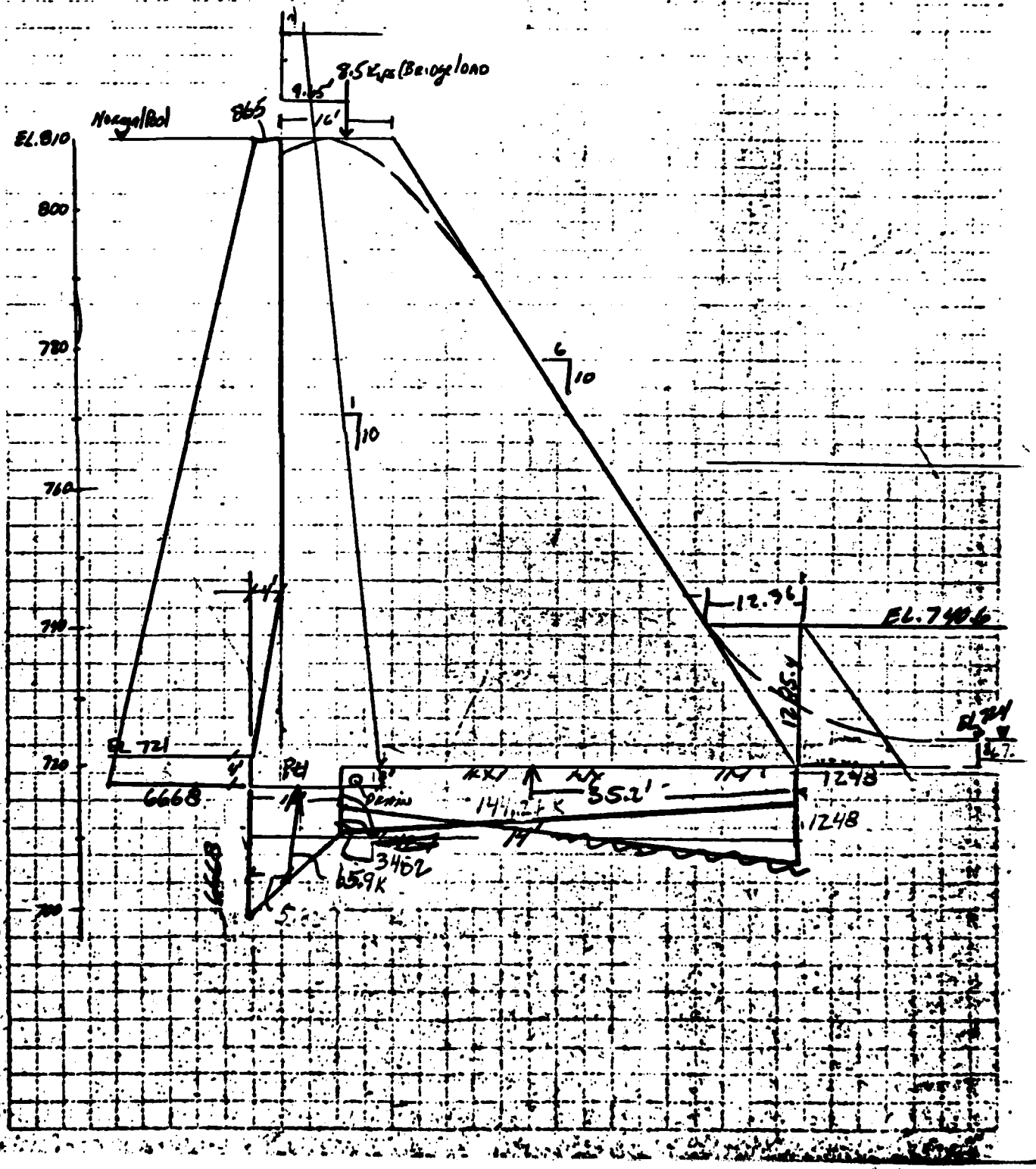
Job No. 1579-19 Sheet 11 of 19

Project NYS Dam Inspection Date 7-31-81

Subject Rio Dam Our Unlines By JW

Ch'k. by

½ PMF



TAMS

Job No. 1529-19 Sheet 12 of 19
Project NYS Dam Inspection Date 7-31-81
Subject Rio Dam - Stability Analysis By JOEW
Ch'k. by

Case III Hydrostatic Pressure Summary

$\Sigma F_H = -302.64$ kips

$\Sigma F_V = -205.6$ kips

$\Sigma M_A = 19,296$ k-ft

Case II Hydrostatic Pressure Cases. PMF Condition
Use 60% of Tailwater Pressures to account for hydrodynamic effect
Reservoir @ El. 829.69
Tailwater @ El. 727.5

Seal Slot 13 for Pressure Distribution

Pressure at top of Spillway El 810

$P = (829.69 - 810)\,62.4 = 1228.6$ psf

Pressure at Base of Dam El 717

$P = (829.69 - 717)\,62.4 = 7031.86$ psf

F_H on upstream face

$\frac{1228.6 + 7031.8}{2} \times 93 = -384.11$ kips

relative to El 810 $\bar{x}$: $\frac{93}{3}\left(\frac{2 \times 1228.6 + 7031.86}{1228.6 + 7031.8}\right) = 35.6'$

$M_A = \bar{x} - 3 = 35.6 - 3 = 32.6'$

TAMS

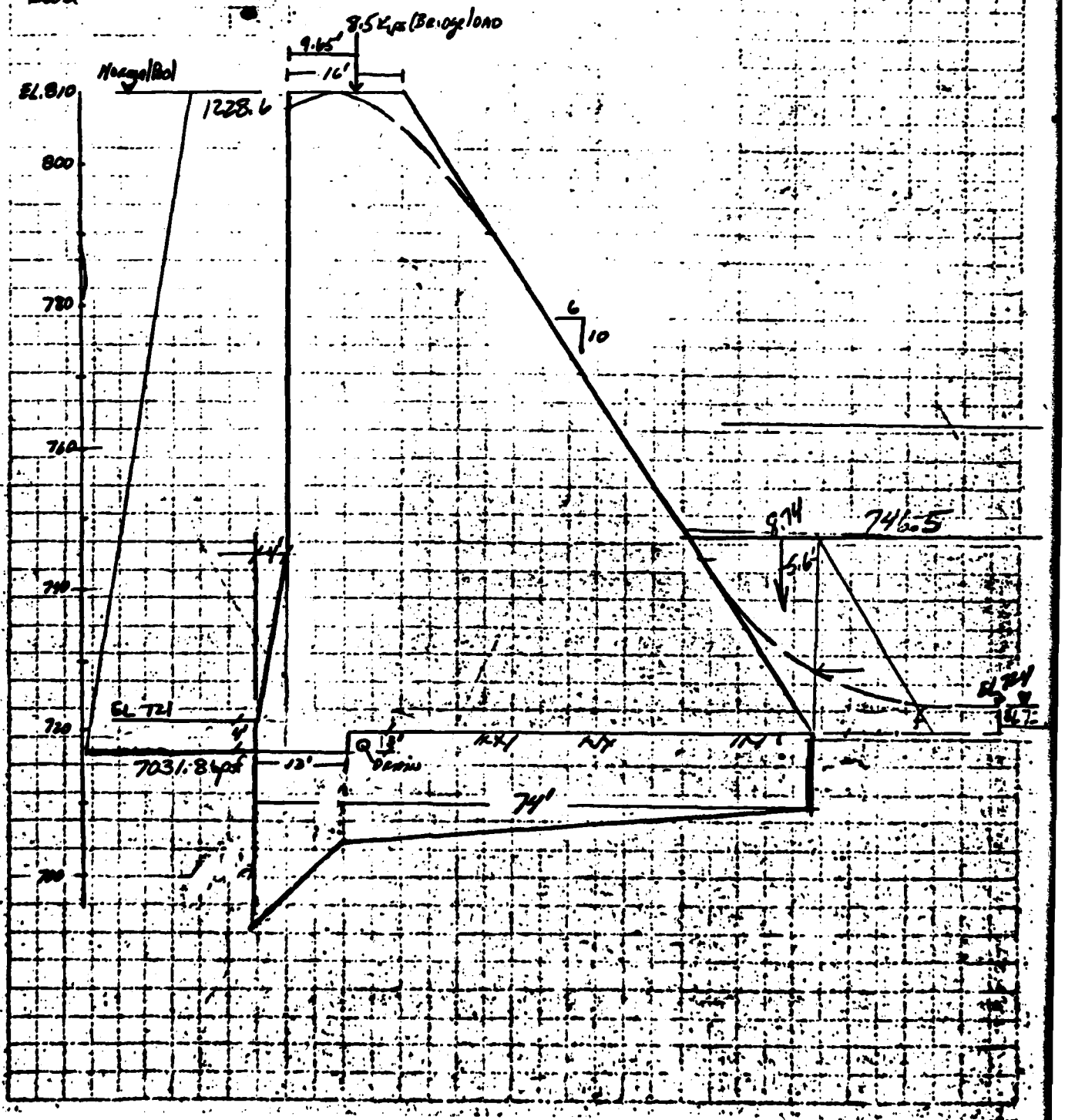
Job No. 1579-19 Sheet 13 of 19

Project NYS Dam Inspection Date 7-31-81

Subject Rio Dam QA Values By JW

Ch'k. by

PMF



TAMS

Job No. 1579-19 Sheet 14 of 19
Project NYS Dam Inspection Date 8-4-81
Subject Rio Dam - Stability Analyses By JW
Ch'k. by

Case IV Cont.
Tailwater Pressure Conditions

Pat Base

$746.5 - 720 = 26.5$
$62.4 \times 26.5 = 1653.6$ psf

$F_V = 16.7 \times 1653.6 \times 1/2 = 13,80\,K \times .6 = 8.28$ kips

$M_A = 16.7/3 = 5.6'$

$F_H = 1/2 \times 1653.6 \times 27.9 = 23.07\,k \times .6 = 13.84$ kips

$M_A = \frac{27.9}{3} = 9.3'$

Base hydrostatic forces

Using assumed 50% drain efficiency, the pressure at the drain is

$P = P_1 + \frac{kx}{L}(P_2 - P_1)$

$= 1653.6 + \frac{.50(61)}{74}(703.8 - 1653.6)$

$= 3870$ psf

F at Heel

$F = \frac{703.8 + 3870}{2} \times 13 = -70.86$ kips

$\bar{x} = 13/3\left(\frac{2 \times 3870 + 703.8}{3870 + 703.8}\right) = 5.87$

$M_A = 74 - 5.87 = 68.1'$

Remaining Uplift F

$F = \frac{3870 + 1653.6}{2} \times 61 = 168.47$ kips

$\bar{x} = 61/3\left(\frac{2 \times 1653 + 3870}{1653 + 3870}\right) = 26.4'$

$M_A = 74 - 13 - 26.4 = 34.6'$

$\Sigma F_H = 370.3$ kips
$\Sigma F_V = -23.05$ kips
$\Sigma M_A = -23,192$ k-ft

TAMS

Job No. 1579-19 Sheet 15 of 19
Project NYS Dam Inspection Date 8-4-81
Subject Rio Dam By JRW
Ch'k. by

Case I Analysis

	ΣF_V (k/ft)	ΣF_H (k/ft)	ΣM_A (k-ft/ft)
Dead Load	579.95	—	26,857
Passive Resistance	—	25.54 ios	—
Hydrostatic Loading	-139.61	-272.2	-13693
Net Σ	440.34	-246.6	13164

$$\bar{e} = \frac{74}{2} - \frac{13164}{440.34} = 7.1$$

Is $\frac{74}{6} - 7.1 \geq 0$ (5.23) yes Resultant location is in middle third of base

Check Bearing Pressure

$$P = \frac{440.34}{74}\left(1 \pm 6\frac{(7.1)}{74}\right)\frac{1000}{144} = 41.32 \pm 23.79 \Rightarrow \begin{matrix} 65.11 \text{ psi} \\ 17.53 \text{ psi} \end{matrix}$$

OK

F.S. Against Sliding

$$F.S. = \frac{(440.34 + 15.11)(\tan 45) + 74(4.5 k_f)}{246.6} = 3.19 > 3$$

Acceptable

TAMS

Job No. 1579-19 Sheet 16 of 19
Project NYS Dam Inspection Date 8-4-81
Subject Rio Dam - Stability Analysis By JW
Ch'k. by

Case II Analysis Ice Loading

	ΣF_v (kips)	ΣF_H (kips)	ΣM_A (k-ft)
Dead Load	579.95	—	26857
Passive Resistance	—	25.54	—
Hydrostatic Loading	-139.61	-272.2	-13093
Ice Load	—	-5.0	-450.0
Net Σ	440.34	-251.6	12714

$$\bar{x} = \frac{74}{2} - \frac{12714}{440.34} = 8.12'$$

Is $\frac{74}{6} - 8.12 = 0$ ($+4.21$) yes Resultant falls within middle 1/3 of base

Check Foundation Pressures

$$P = \frac{440.34}{74}\left(1 \pm \frac{6 \times 8.12}{74}\right)\frac{1000}{144} = 41.32 \pm 27.2 \text{ psi}$$

Acceptable for Rock Foundation
- 9867 psf = 68.52 psi
- 2033 psf = 14.12 psi

OK

F.S. Against Sliding

$$\frac{(440.34 + 15.11)\tan 45° + 74(4.5)}{257.6} = 3.137 > 3$$

OK

TAMS

Job No. 1529-19 Sheet 12 of 19
Project NYS Dam Inspection Date 8-4-81
Subject R10 Dam - Stability Analyses By JGL
Ch'k. by

Case III ½ PMF

	ΣF_H (kips)	ΣF_V (kips)	ΣM_A (k-ft)
Dead load	579.95		26,857
Passive Resistance		25.54	
Hydrostatic Loading	-205.6 / 374.35	-302.64 / -277.1	-19,296 / 7561

Find eccentricity $\bar{e}$

$$\bar{e} = \frac{74}{2} - \frac{7561}{374.35} = 20.19'$$

Is resultant within Central 1/3 of base

Only if $\frac{74}{6} - |20.19'| \geq 0$ (-7.53) NO resultant located outside middle 1/3

Check Foundation Pressures

$$P = \frac{374.35}{74}\left(1 \pm \frac{6(20.19')}{74}\right) \times \frac{1000}{144}\ psi = 35.13 \pm 57.51$$

yields the range 92.64 psi to -22.38 psi
acceptable for sound rock foundation

F.S. against sliding

$$F.S. = \frac{(374.35 + 15.11)\tan 35^\circ + 74(4.5\ ksf)}{277.1} = 2.60 < 3$$

Does NOT meet criteria

TAMS

Job No. 1579-19 Sheet 18 of 19
Project NYS Dam Inspection Date 8-4-87
Subject Rio Dam. - Stability Analysis By JW
Ch'k. by

Case II PMF Condition

	ΣF_V (kips)	ΣF_H (kips)	ΣM_A (k-ft)
Dead Load	579.95	—	26,857
Passive Resistance	—	25.54	—
Hydrostatic Loads	-231.05	-370.3	-23,192
	348.9	-344.76	3665

Find eccentricity e

$$\bar{e} = \frac{74}{2} - \frac{3665}{348.9} = 26.49'$$

Is Resultant within middle 1/3

only if $\frac{74}{6} - 26.49 \geq 0$ (-14.16) NO Resultant NOT within middle 1/3

Check Bearing Pressure

$$P = \frac{348.9}{74}\left(1 \pm \frac{6(26.49)}{74}\right)\frac{1000}{144}\ psi = 32.74 \pm 70.32\ psi$$

$= 103.07$ to -37.58 psi

↓

Acceptable range

F.S. Against Sliding

$$F.S. = \frac{(348.9 + 15.11)(\tan 45 + 74(4.5)}{344.76} = 2.02$$

< 3.0

NOT WITHIN CRITERIA

TAMS

Job No. 1579-19 Sheet 19 of 19
Project NYS Dam Inspection Date 9-4-81
Subject RIO Dam - Stability Analysis By JCL
Ch'k. by

Summary

Case	F.S. Against Sliding	Eccentricity of Resultant Force	Foundation Pressure
I	3.19	within middle 1/3	65.11 / 17.53 psi
II	3.13	within middle 1/3	68.52 / 14.12 psi
III	2.60	7.53 ft outside middle 1/3	92.64 / -22.4 psi
IV	2.02	14.16 ft outside middle 1/3	103.07 / -37.58 psi

REFERENCES

APPENDIX F

REFERENCES

1. "Recommended Guidelines for Safety Inspection of Dams", Department of the Army, Office of the Chief of Engineers, Appendix D.

2. "Upper Delaware River Basin, Hydrologic Flood Routing Model", Department of the Army, Corps of Engineers, New York District, October 1976.

3. "Seasonal Variation of the Probable Maximum Precipitation, East of the 105th Meridian for Areas from 10 to 1,000 Square Miles, and Durations of 6, 12, 24 and 40 Hours", Hydrometeorological Report No. 33. Weather Bureau, U.S. Department of Commerce, April 1956.

4. "Flood Hydrograph Package (HEC-1) Users Manual for Dam Safety Investigations", U.S. Army Corps of Engineers, Hydrologic Engineering Center, September 1979.

OTHER DATA

APPENDIX G

8-26-21-1000 (C-1905)

NY 497

STATE OF NEW YORK
DEPARTMENT OF

State Engineer and Surveyor

ALBANY

Received Dec 22 - 1925 Dam No. 86 Del Watershed

Disposition Approved Jan 5 - 1926 Serial No. 566

Foundation inspected

Structure inspected

Application for the Construction or Reconstruction of a Dam

Application is hereby made to the State Engineer, Albany, N. Y., in compliance with the provisions of Chapter LXV of the Consolidated Laws and Chapter 647, Laws of 1911, Section 22 as amended, for the approval of specifications and detailed drawings, marked KK-3-50-52-53-54-55-56 and 58

herewith submitted for the {construction / xxxxxxxxxx} of a dam located as stated below. All provisions of law will be complied with in the erection of the proposed dam. It is intended to complete the work covered by the application about November 1st, 1927 (Date)

1. The dam will be on Mongaup River flowing into Delaware River in the town of Deer Park and Lumberland, County of Orange and Sullivan and 3 miles from its confluence with the Delaware River (Give exact distance and direction from a well-know bridge, dam, village main cross-roads or mouth of a stream)

2. The name and address of the owner is Catskill Power Corpn., Middletown, N. Y.

3. The dam will be used for hydro-electric power

4. Will any part of the dam be built upon or its pond flood any State lands? no

5. The watershed at the proposed dam draining into the pond to be formed thereby is 195 square miles.

6. The proposed dam will have a pond area at the spillcrest elevation of 410 acres and will impound 580,000,000 cubic feet of water.

7. The lowest part of the natural shore of the pond is 500 feet vertically above the spillcrest, and everywhere else the shore will be at least 500 feet above the spillcrest.

8. The maximum known flow of the stream at the dam site was - cubic feet per second on no records (Date)

9. State if any damage to life or to any buildings, roads or other property could be caused by any possible failure of the proposed dam no

10. The natural material of the bed on which the proposed dam will rest is (clay, sand, gravel, boulders, granite, shale, slate, limestone, etc.) sandstone

11. The material of the right bank, in the direction with the current, is ledge; at the spillcrest elevation this material has a top slope of - inches vertical to a foot horizontal on the center line of the dam, a vertical thickness at this elevation of - feet, and the top surface extends for a vertical height of - feet above the spillcrest.

12. The material of the left bank is ledge; has a top slope of - inches to a foot horizontal, a thickness of - feet, and a height of - feet.

13 State the character of the bed and the banks in respect to the hardness, perviousness, water bearing, effect of exposure to air and to water, uniformity, etc. no loss of water in any bore hole

14. If the bed is in layers, are the layers horizontal or inclined? horizontal If inclined what is the direction of the horizontal outcropping relative to the axis of the main dam and the inclination and direction of the layers in a plane perpendicular to the horizontal outcropping

15. What is the thickness of the layers? 4 ft. to 8 ft.

16. Are there any porous seams or fissures? No

17. WASTES. The spillway of the above proposed dam will be 240 feet long in the clear; the waters will be held at the right end by a concrete abutment the top of which will be 15 feet above the spillcrest, and have a top width of 19 feet; and at the left end by a concrete abutment the top of which will be 15 feet above the spillcrest, and have a top width of 19 feet.

18. There will be also for flood discharge a pipe - inches inside diameter and the bottom will be - feet below the spillcrest, a sluice or gate - feet wide in the clear by - feet high, and the bottom will be - feet below the spillcrest.

19. APRON. Below the proposed dam there will be an apron built of concrete, 160 feet long across the stream, 32 feet wide and 4 feet thick. The downstream side of the apron will have a thickness of - feet for a width of - feet.

20. PLANS. Each application for a permit of a dam over 12 feet in height must be accompanied by a location map and complete working drawings in triplicate of the proposed structure, one set of which will be returned if they are approved. Each drawing should have a title giving the parts shown, the name of the town and county in which the dam site is located, and the name of the owner and of the engineer.

The location map (U. S. Geological Quadrangle or other map) should show the exact location of the proposed dam; of buildings below the dam which might be damaged by any failure of the dam; of roads adjacent to or crossing the stream below the dam, giving the lowest elevation of the roadway above the stream bed and giving the shape,

the height and the width of stream openings; and of any embankments or steep slopes that any flood could pass over. Also indicate the character and use made of the ground below the dam.

The complete working drawings should give all the dimensions necessary for the calculations of the stability of the structure, and all the information asked for below under "Sketches." There may be attached to the application any written reports, calculations, investigations or opinions that may aid in showing the data and method used by the designer. State the assumed ice and uplift pressures and the conditions on which based.

21. SKETCHES. For small and unimportant structures, if plans have not been made, on the back of this application make a sketch to scale for each different cross-section at the highest point; giving the height and the depth from the surface of the foundation, the bottom width, the top width (for a concrete or masonry spill at 18 inches below the crest), the elevation of the top in reference to the spillcrest, the length of the section, and the material of which the section is to be constructed; on the spillway section show a cross section of the apron, giving its width, thickness and material; and show the abutment or wash wall at the end of the spillway, giving its heights and thickness. Mark each section with a capital letter. Also sketch a plan; show the above sections by their top lines, giving the mark and the length of each; the openings by their horizontal dimensions; the abutments by their top width and top lengths from the upstream face of the spillcrest; and outline the apron. Also sketch an elevation of each end of the dam with a cross section of the banks, giving the depth and width excavated into the banks.

22. ELEVATIONS. Also give the elevations, if possible from the Mean Sea Level, of at least two permanent Bench Marks; of the spillcrest for any existing dam on the proposed dam site, at the middle and at the ends of the spill; of the spillcrest for the above proposed dam; and of the spillcrest of any adjacent dams.

23. SAMPLES. When so instructed, send samples of the materials to be used in the construction of the proposed dam, using shipping tags which will be furnished. For sand, one-half a cubic foot is desired (exclusive of any stone over ¼ inch in size mixed therewith); for cement, three pints; and for the natural bed, twenty cubic inches if of ledge and one-half a cubic foot if of soil.

24. INSPECTION. State how inspection is to be provided for during construction. by competent resident engineer

25. WATER SUPPLY. Are the waters impounded by the above dam to be used for a public water supply? no Has an application under the provisions of Article IX of the Conservation Law for such use been made to the Water Control Commission, Albany, N. Y.?

Name and address of Designing Engineer — Chas. T. Main
200 Devonshire St., Boston, Mass.

Engineers License Number 6146

The above information is correct to the best of my knowledge and belief.

200 Devonshire St., Boston, Mass.
(Address of signer)

CATSKILL POWER CORPORATION
CHARLES H. TENNEY & CO., Engineers

December 21, 1925
(Date)

Vice President in Charge of Engineering
(A person signing for owner should indicate his title or authority)

K10 Reservoir

DAM INSPECTION REPORT
(By Visual Inspection)

Dam Number	River Basin	Town	County	Hazard Class*	Date & Inspector
86	Delaware	Lumberland Deer Park	Sullivan Orange	C	10/12/76 JVE

Type of Construction

- [x] Earth w/concrete spillway
- [ ] Earth w/drop inlet pipe
- [ ] Earth w/stone or riprap spillway
- [ ] Concrete
- [ ] Stone
- [ ] Timber

Use

- [ ] Water Supply
- [x] Power
- [ ] Recreation
- [ ] Fish and Wildlife
- [ ] Farm Pond
- [ ] No Apparent Use-Abandoned

Estimated Impoundment Size

- [ ] 1-5 acres
- [ ] 5-10 acres
- [x] Over 10 acres

Estimated Height of Dam above Streambed

- [ ] Under 10 feet
- [ ] 10-25 feet
- [x] Over 25 feet

Condition of Spillway

- [x] Service satisfactory
- [ ] In need of repair or maintenance
- [x] Auxiliary satisfactory
- [ ] In need of repair or maintenance

Explain: Concrete starting to show age — Some work done on abutment walls to preserve concrete

Condition of Non-Overflow Section

- [x] Satisfactory
- [ ] In need of repair or maintenance Explain: _____

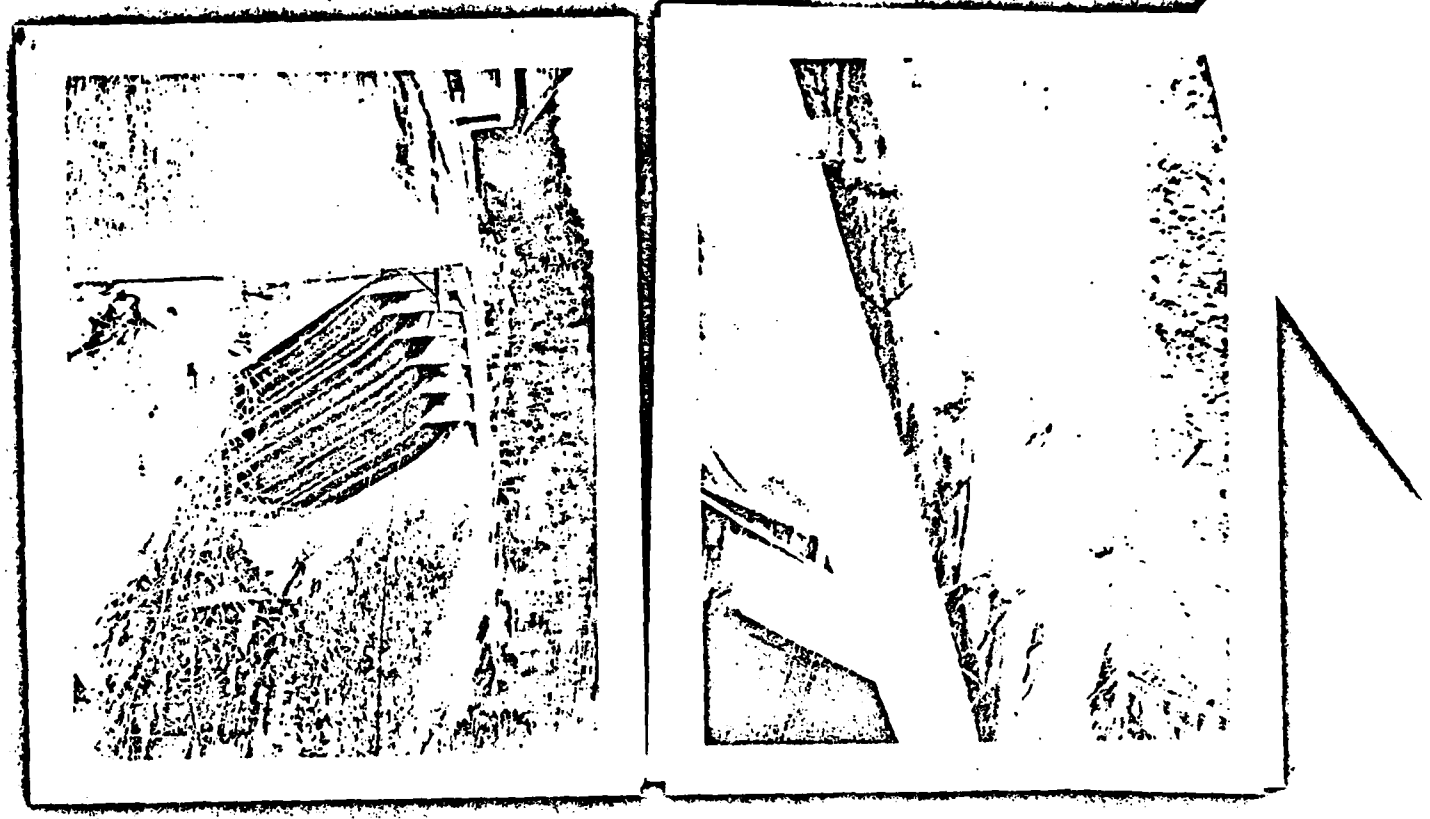
Condition of Mechanical Equipment

- [x] Satisfactory
- [ ] In need of repair or maintenance Explain: _____

Evaluation (From Visual Inspection)

- [x] No defects observed beyond normal maintenance
- [ ] Repairs required beyond normal maintenance

*Explain Hazard Class, if Necessary Very high with large impoundment



ORANGE AND ROCKLAND UTILITIES, INC.

one blue hill plaza, pearl river, new york, 10965 914-352-6000

writer's direct dial number 914-627-2648

July 16, 1981

Mr. Jyotindra Patel
Tippetts-Abbett-McCarthy-Stratton
The TAMS Building
655 Third Avenue
New York, New York 10017

Re: National Dam Inspection Program
Rio Dam, N.Y. 497

Dear Mr. Patel:

Enclosed herewith is a tabulation of the weir monitoring program for Rio Dam which has been in effect since November 1979.

The existing weirs have been in place for at least 25 years. However, as a result of our engineering offices being relocated several times over the past years, these records are either misplaced or lost.

We have a copy of an insurance report (also enclosed) made in 1964 indicating a leakage at the dam of 193 gallons per minute. This report also includes a good deal of background information about the design and construction of the dam which should be helpful in the compilation of your report.

If there is any other information you need, please contact us and we will be glad to assist you in this matter.

Very truly yours,

R.O. Wanvig

ROW/ct
Encs.

R. O. Wanvig
Senior Civil Engineer

RIO DAM - WEIR MONITORING

Date	11/30/79	1/2/80	4/22/80	8/1/80	10/14/81	5/1/81
Rio.-Elev.	811.8	811.2	811.8	811.5	811.0	812.2
Weir No.		FLOW - Gal. per Min.				
1. 18" Box (stream)	137.0	104.0	202.0	29.6	3.0	104.0
2. 48" Box	314.0	314.0	425.5	192.0	240.0	453.0
3. 4" Pipe (Stream)	3.0	2.5	0	2.1	3.0	1.0
Net Leakage 2 - (1+3)	174.0	207.5	223.5	160.3	234.0	348.0

NOTE: Previous records of seepage have been lost or are unavailable. A copy of an insurance report (enclosed herewith) made June 1964 reveals that seepage was 193 gpm with Rio Reservoir at elevation 812.0'. This figure basically agrees with the current net leakage figures shown above.

The reading on 5/1/81 was taken after a very heavy rain fall and the lake elevation well above normal.

ROW/dd

July 13, 1981

6/4/64

ORANGE AND ROCKLAND UTILITIES, INC.

The Dam or Structure - Rio Dam - Deerpark and Lumberland, New York

1. By whom designed - Chas. T. Main, Inc., Boston, Massachusetts.

2. By whom constructed - Fred T. Ley & Co., Springfield, Massachusetts.

3. Year constructed - 1926-1927.

4. Type
   Concrete

5. Size
   a. Length - Spillway 264 feet; total including abutments and earth embankments 1500 feet.
   b. Height - 90 feet to spillway crest (maximum).
   c. Width at base - At spillway 100 feet.
   d. Width at top - About 10 feet - Ogee section.

6. Anchorage
   a. How are wings of dam secured? The concrete abutment walls are built into rock ledge. The earth embankments flanking the two abutment walls are founded on earth and tie into the earth hillside.
   b. Foundation under dam: Spillway section is founded on rock.

7. Water Impounded
   a. Area of pond surface is 460 acres with water at top of 5-ft. flashboards (Elevation 815).
   b. Average depth - 33 feet.
   c. Depth at spillway - 5 feet with water at top of 5-ft. flashboards.
   d. Depth at dam - 90 feet maximum
   e. Water Supply
      1. River.
   *f. Length of time to refill - 45 days in average water year.
   ** 1. Approximate area of water used - 2200 acre feet.
   g. What is water used for? Hydroelectric power.

8. Control
   a. Gates - None except head gates to power penstock.
      1. Size - 9.5 ft. x 12.5 ft.
      2. Number - One.
      3. Location with respect to bottom of dam: Centerline of gate 49.5 fee above.
   b. Diversion tunnels - None as such, but there is one 11-ft. diameter wood penstock supplying water to the Rio Power Plant.
   c. Spillway
      1. Size - 240 feet long at crest of concrete dam.
      2. Elevation with top of dam: At top.

NOTES:
*Assumes no water released during refill period -- only Rio drainage area used t determine runoff (15 square miles).

Condition

1. Maintenance, Inspection and Operation -- Inspected weekly and maintained as necessary.
2. Erosion or deterioration of dam structure -- Dam structure in good condition.
3. Seepage: With water at elevation 812 193 gpm [illegible] seepage around the eastern earth embankment.
4. Property around lake is mostly undeveloped forest land. Employees' recreation area and some private hunting and fishing clubs.
   a. Lowering of water affects use of lake for recreation to some extent.

Public Exposure at Dam Site

1. Road across dam? Yes - public.
2. Is public allowed access to dam? See 1 next above.
3. Is supervision maintained full time? No.

Conditions Downstream from Dam

1. River bed drops about 95 feet in the 8,000 feet between the dam and the point where water re-enters the river after going through the Rio power-house.
2. Width of valley below dam is approximately 1800 feet at elevation of top of dam.
3. Spillway discharges into this valley.
4. Number of bridges that might be affected by flood conditions should dam rupture:
   Assuming that this question refers only to public bridges over the Mongaup River, there is one bridge over the river on Highway 97 near the confluence of the Mongaup and Delaware Rivers.
   a. Give size and stability of structure: Not known.
5. Buildings and structures that would be affected by dam failure (power plants, piers, etc.):
   The power plant of Orange and Rockland which might be affected is the Rio Plant.
6. Dams, weirs and flood gates in streambed which might be affected by dam failure:
   If this question refers to the Mongaup River, there are no other dams which would be affected by the failure of the Rio Dam.